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IDENTIFIERS Direct Instruction; Flexibility (Psychomotor); Student Engagement; Total Physical Response

ABSTRACT

This document presents the course syllabus for Education 590 Culminating Experience at the University of Tennessee at Chattanooga's teacher licensure program. It also includes action research projects from spring 2003: "'To Track or Untrack...That Is the Question'" (Sarah Armes); "Providing Urban Students with the Motivation to Succeed in School" (Laura K. Cline); "Understanding the Structure of DNA" (Gary S. Dunn); "The Effectiveness of Direct Instruction with High Priority (Low Performing) Middle School Students" (Andrew Falk); "Pythagorean Theorem Learning Assessment in Urban High School Geometry" (William A. Floyd); "Flexibility with the Sit and Reach Test" (Heather Huffman); "Total Physical Response Storytelling and Vocabulary Retention in Second Language Learning" (Christina L. McCombs); "The Use of Mnemonic Devices in the Teaching of Mathematics in Middle School: What a Group of Eighth Graders Remember that Help Them Solve Math Problems" (Charles C. Milam, Sr.); "Learning through Directed Instruction vs. Cooperative Learning" (Julie Burnes Novak); "Effects of Emphasizing the Processes of Scientific Inquiry in Relation to Student Motivation and Achievement in the Middle School Science Curriculum" (John Ramey); "The Merits of Geography Teaching that Engages and Provides Experiential Learning for Students" (John Shearer); "Children's Theatre" (Erianona M. Vali); and "Gender Bias in the Science Classroom: An Analysis of the Science TCAP Achievement Test for 2002" (Jason Wohlers). (Papers contain references.) (SM)

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ED 481 396

Culminating Experience Action Research Projects, Volume 3, Spring 2003

Edited by
Deborah A. McAllister and Peggy S. Moyer

College of Education and Applied Professional Studies
The University of Tennessee at Chattanooga

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Introduction

As a part of the teacher licensure program at the graduate level at The University of Tennessee at Chattanooga (UTC), the M.Ed. Licensure candidate is required to complete an action research project during a 3-semester-hour course that coincides with the 9-semester-hour student teaching experience. This course, Education 590 Culminating Experience, requires the student to implement an action research plan designed through (a) the Education 500 Introduction to Inquiry course, (b) one of the two learning assessments required during student teaching, or (c) a newly-designed project not used as one of the learning assessments.

With funding through a UTC Teaching, Learning, and Technology Faculty Fellows award, the Education 590 course was conducted through the use of an online, course management system (Blackboard 5), allowing for asynchronous discussion and use of the digital drop box feature for submitting required papers.

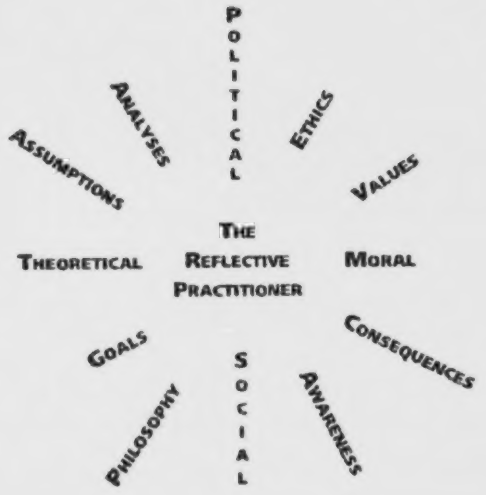
The course syllabus for Education 590 Culminating Experience is presented in the next section, followed by action research projects from spring semester 2003.

Deborah A. McAllister

Peggy S. Moyer

July 2003

Educ 590 Culminating Experience
Spring 2003
Section 001 By Appointment, 3 credit hours


POLITICAL
ANALYSES
ETHICS
ASSUMPTIONS
VALUES
THE REFLECTIVE PRACTITIONER
THEORETICAL
MORAL
CONSEQUENCES
GOALS
SOCIAL
AWARENESS
PHILOSOPHY

ATTENTION: If you are a student with a disability (e.g., physical, learning, psychiatric, vision, hearing, etc.) and think that you might need special assistance or a special accommodation in this class or any other class, call the Office for Students with Disabilities/College Access Program at 425-4006 or come by the office, 110 Frist Hall.

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Educ 590 Culminating Experience – Spring 2003
Section 001 By Appointment, 3 credit hours

Instructor

Dr. Deborah A. McAllister
Office: Hunter 310C
Office hours: M 10:00 a.m. to 12:00 p.m., 2:00 p.m. to 5:00 p.m., Tu 1:30 p.m. to 3:30 p.m., or by appointment
Phone: 423-425-5376 (Office), 423-842-1607 (Home)
Email: Deborah-McAllister@utc.edu
Graduate Assistant: Peggy Moyer, peggy-moyer@gem.utc.edu
Graduate Assistant/Research Assistant: John Peoples, john-peoples@gem.utc.edu

Catalog description

Directed research or development project under faculty supervision. *Prerequisite: Admission to candidacy, approval of M.Ed. committee.*

Recommended text and web sites (text was ordered for Educ/Epsy 501)

American Psychological Association. (2001). *Publication manual of the American Psychological Association* (5th ed.). Washington, DC: Author.

Online Writing Lab at Purdue University. (2002, September). *Using APA format.* Retrieved December 30, 2002, from the Purdue University OWL Web site: http://owl.english.purdue.edu/handouts/research/r_apa.html

Degelman, D., & Harris, M. L. (2002, December 20). *APA style essentials.* Retrieved December 30, 2002, from the Vanguard University Web site: http://www.vanguard.edu/faculty/ddegelman/index.cfm?doc_id=796

University of Wisconsin - Madison Writing Center. (2002). *Writer's handbook: APA documentation style.* Retrieved December 30, 2002, from the University of Wisconsin - Madison Writing Center Web site: http://www.wisc.edu/writing/Handbook/DocAPA.html

Objectives

1. The student can apply a variety of research strategies for use in the elementary, middle grades, and/or secondary classroom, or with professionals in the field. Reflective decision making, a process involving reading, reflecting, and responding, will be applied by the student to evaluate ongoing research techniques, procedures, and materials, in order to become a reflective practitioner.
2. The student will select or design surveys and/or rubrics for data collection in the content area.
3. The student will understand current issues in the content area, including current research methods, materials, professional development and grant opportunities, and programs suitable to all learners, from exceptional populations to diverse ethnic and cultural groups.
4. The student will demonstrate the ability to connect new learning with prior knowledge and skills through a case study conducted during the Induction Experience.

Requirements

1. Select a case study option:
   a. Implementation of the project designed in Educ 500 as your case study. Include modifications to the project, if necessary, based on knowledge gained since the completion of Educ 500. Submit a corrected copy.
   b. Plan to use one of your learning assessments from one of your placements as your case study. Submit an outline of the topic, what will be assessed, who will be assessed, how and when assessment will occur, and what instruments will be used. Submit an outline.
   c. Design a new project of your own choosing. Submit an outline for my approval.

2. **Prior to data collection, complete the REQUIRED process for UTC's Institutional Review Board For the Protection of Human Research Subjects (http://www.utc.edu/~instrb/). Request either an Exemption from IRB Review (Form A) or an Expedited Review (Form B). Form C must be completed at the end of the study. Review the information and forms on the IRB web site for additional details. An Exemption requires approximately 1 week to process. If an Expedited review falls under the Exemption, it will be reviewed as such. (Full board approval is required if there is more than minimal risk to the subject.) Any updates to the IRB process will be followed.**

3. Implementation of the project will be completed during the Induction Experience (Educ 596). Make a decision on the placement at which it will be completed. Implementation **cannot** occur prior to IRB approval.

4. Completion of the written project, **in APA style**. Include the following elements:
   a. Introduction to the problem. Why was this topic selected for study? Is this topic a current national, state, or local issue? Is this topic a staple of the curriculum in your field? Etc.
   b. Review of literature. Use at least five refereed sources. The online ERIC advanced search should be used to locate references in educational journals and documents. See http://ericir.syr.edu/Eric/adv_search.shtml.
   c. Data Collection and results. Describe data collection procedures. Provide results of the project, in narrative form and including a chart and/or graph to display the data collected. Analysis of results is from the perspective of higher order cognitive skills. Use descriptive statistical measures (mean, median, mode, frequency distribution, charts, graphs, etc.) for communication of project results. Charts and graphs are imported from Excel to Word and cited as tables and figures. See Microsoft Excel [spreadsheet] software, used in Educ 575.
   d. Conclusions and recommendations. What generalizations, if any, can be made, based on the results of the case study? What is the consensus of your professional organization with regard to the problem studied? What recommendations would you make for teacher professional development? Is grant money available to support further research in this area? What role could be assumed by the use of technology in this area? Please address all items in this section.
   e. Copies of the instrument(s) used for data collection. Instrument(s) are placed in individual appendices. Word process instruments from the Web, books, etc., but place a citation on the page and in the reference list.

5. Communication:
   a. Current email address registered with UTC for communication between student and instructor. The UTC gem (generic electronic mailbox) address will point to the address you have on file. You may register for a UTC email address on the moccasun server which can be accessed through UTC's webmail. See http://www.utc.edu/acadcomp/students.htm and http://webmail.utc.edu/.
   b. Web access to check course announcements and post messages to the discussion forum on Blackboard a minimum of once per week. See http://utconline.utc.edu/.

6. All work is to be computer-generated and turned in through the Blackboard digital drop box. You may complete your project either on the Macintosh or Windows platform. Please use Microsoft Word and Microsoft Excel. If other software is to be used, please ask for approval. Keep a copy of your work on a hard drive or a disk so that it can be accessed, if needed. Reminder: You will need a student ID card to use the university student lab in Siskin Memorial.

7. Please note:
   a. Ask another person to proofread your work for correct syntax and semantics before submitting it. You are encouraged to post it to the Blackboard discussion forum.
   b. The Writing Center is located in 119 Holt Hall. See http://www.utc.edu/~scribble/ for hours and information.
   c. Case studies may be displayed at a professional meeting and/or gathered for a publication.

Grading rubric

Criteria	A	B	C	F
Project outline and IRB approval	Submitted online. Submitted for IRB approval; approval received.	Submitted online. Submitted for IRB approval; approval received.	Submitted online. Submitted for IRB approval; approval received.	Not submitted online. Not submitted for IRB approval, or IRB approval denied.
Instruments	Items appear to be reliable and valid for the case study.	Items appear to be reliable and valid for the case study.	Reliability or validity is questionable.	Reliability and validity cannot be defended.
Data collection and results	Narrative gives descriptive account of data collection and results, and higher order analysis of results; data chart and graph display results accurately and appropriately.	Narrative provides descriptive account of data collection and results, but analysis of results is weak; data chart and graph display results satisfactorily.	Narrative provides limited descriptive account of data collection and results; analysis of results is flawed; data chart and graph display results, but contain errors.	Neither narrative nor chart and graph convey the data collection procedures and results of the study.
Conclusions and recommendations	Provides a cohesive summary to the project; all recommendation areas addressed satisfactorily.	Provides a cohesive summary to the project; most recommendation areas addressed satisfactorily.	Summary lacks insight to the intent of the project; recommendation areas not completely addressed.	Conclusions do not reflect results; recommendation areas not completely addressed.
APA style	APA style elements present: headings, subject-verb agreement, citations, references, abbreviations, commas, semicolons, lists, tables, figures, appendices, etc.	APA style elements present, with minor errors.	Ideas are understandable; acceptable writing style, though not APA.	Written style is inconsistent; difficult to follow the flow of ideas.
Spelling and typographical errors	No spelling errors; minimal typographical errors; correct use of plural and possessive forms.	Spelling and typographical errors present.	Errors detract from quality of project.	Poorly written.
Completion time	All elements completed on time.	Major elements completed on time; some minor elements late.	Most major elements completed late; some or most minor elements late.	No time deadline.
Communication	Open communication between student and instructor. Progress message posted to the discussion forum at least weekly.	Response time is less than once each week.	Response time is less than once in 2 weeks	Response time is less than once in 4 weeks.
Professional quality and usefulness	Previous and current suggestions, and modifications, fully incorporated into project outline; project is relevant to education.	Previous and current suggestions, and modifications, selectively incorporated into project outline; project is relevant to education.	Previous and current suggestions, and modifications, minimally incorporated into project outline; project is relevant to education.	Previous and current suggestions, and modifications, not incorporated into project outline; project has little relevance to education.
Represents graduate level work	Completed project is presented as a coherent whole.	All project elements present but project is not presented as a coherent whole.	One or more project elements missing; project is not presented as a coherent whole.	Major project elements missing; project is not presented as a coherent whole.

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	Week (Tentative course schedule, subject to change)	**Assignment due**
First placement		
1	Week of 01/06/03 Meetings - MTu 01/06 - 01/07, 8:30 a.m. - 5:00 p.m. Placement begins - W 01/08 Explanation of syllabus - W 01/08, 5:00 p.m., Hunter 206 IRB meets – Th 01/09	Check email account; access Blackboard
2	Week of 01/13/03	Case study option selected; proposed outline posted to discussion forum **Paperwork submitted for IRB approval (Exemption/Form A, Expedited Review/Form B)** **Copy of IRB approval placed in my mailbox in Hunter 311, when received**
3	Week of 01/20/03 MLK Holiday - M 01/20 (UTC and HCDE)	Begin case study work on introduction and review of literature; place file in digital drop box for a check of APA style
4	Week of 01/27/03	For a first placement case study, instruments submitted for approval
5	Week of 02/03/03 IRB meets – Tu 02/04	For a first placement case study, begin data collection
6	Week of 02/10/03 Parent Teacher Conference (1/2 day) - F 02/14	Case study work continues
7	Week of 02/17/03 Presidents' Day Holiday - M 02/17 (HCDE)	Case study work continues
8a	Week of 02/24/03 First placement ends - Tu 02/25 Meeting - W 02/26, 8:30 a.m. - 5:00 p.m.	For a first placement case study, the data collection is complete
Second placement		
8b	Week of 02/24/03 Second placement begins - Th 02/27	Case study work continues
9	Week of 03/03/03 IRB meets – Th 03/06	Case study work continues For a second placement case study: Case study option selected; proposed outline posted to discussion forum **Paperwork submitted for IRB approval (Exemption/Form A, Expedited Review/Form B)** **Copy of IRB approval placed in my mailbox in Hunter 311, when received**
10	Week of 03/10/03 HCDE Teacher Professional Development - Th 03/13 (Elem.), F 03/14 (Middle/High) End of third quarter - F 03/14 UTC spring break	Case study work continues For a second placement case study: Begin case study work on introduction and review of literature; place file in digital drop box for a check of APA style
11	Week of 03/17/03	For a second placement case study, instruments submitted for approval
12	Week of 03/24/03	For a second placement case study, begin data collection
13	Week of 03/31/03 TCAP 03/31 – 04/04 IRB meets – Tu 04/01	Case study work continues

14	Week of 04/07/03 HCDE spring break	Case study work continues
15	Week of 04/14/03 Good Friday Holiday – 04/18 (UTC and HCDE)	For a second placement case study, the data collection is complete
16	Week of 04/21/03 Second placement ends - F 04/25	**Completed case study due, 04/25/03, 5:00 p.m.** **Assembled in a single file; placed in digital drop box** **IRB Form C completed and placed in my mailbox in Hunter 311**
17	Week of 04/28/03 Meeting - M 04/28, 8:30 a.m. – 12:00 p.m. W 04/30/03 - Grades due for graduation candidates, 12:00 p.m. Th 05/01/03 - Grades due for all other students, 12:00 p.m. Su 05/04/03 - Commencement, 2:00 p.m.	

APA style (general guidelines; use reverse indent)

1. Journal

Last name, Initials., & Last name, Initials. (year). Title of the article in lower case letters except first letter of the title and proper nouns. *Journal name, volume*(number), page number-page number.

Many, W., Lockard, J., Abrams, P., & Friker, W. (1988). The effect of learning to program in Logo on reasoning skills of junior high school students. *Journal of Educational Computing Research, 4*(2), 203-213.

2. Book

Last name, Initials., & Last name, Initials. (year). *Title of the book in lower case letters except first letter of the title and proper nouns.* Place of publication: Publishing Company.

Turner, T. N. (1994). *Essentials of classroom teaching elementary social studies.* Needham Heights, MA: Allyn and Bacon.

3. Software

Last name, Initials., & Last name, Initials. (year). *Title of the Software in Upper Case First Letters* [Computer software]. Place of publication: Publishing Company.

Microsoft Corporation. (1996). *Encarta 97 Encyclopedia* [Computer software]. Redmond, WA: Author.

In example 3, the author and the publishing company are the same, so the word 'Author' is used.

4. Online source

Last name, Initials., & Last name, Initials. (year). *Title of the web site in lower case letters except first letter of the title and proper nouns.* Retrieved today's date, from complete URL

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Retrieved December 30, 2002, from http://standards.nctm.org/

In example 4, I omit the period '.' at the end so it will not be confused in the address. Others choose to leave one space, then place the period at the end of the URL.

Rubrics (examples)

Barnard, P. (2002, December 5). *Learning central @ Pioneer: Rubric resources.* Retrieved December 30, 2002, from http://www.asd.wednet.edu/pioneer/barnard/index.htm

Chicago Public Schools. (2000). *The rubric bank.* Retrieved December 30, 2002, from http://intranet.cps.k12.il.us/Assessments/Ideas_and_Rubrics/Rubric_Bank/rubric_bank.html

Chicago Public Schools. (2000). *How to create a rubric.* Retrieved December 30, 2002, from http://intranet.cps.k12.il.us/Assessments/Ideas_and_Rubrics/Create_Rubric/create_rubric.html

Coxon, E. (2002, December 21). *Rubrics from the staff room for Ontario teachers.* Retrieved December 30, 2002, from http://www.odyssey.on.ca/~elaine.coxon/rubrics.htm

LessonPlanZ.com. (2002, December 29). Retrieved December 30, 2002, from http://lessonplanz.com/ (use 'rubric' as a search term)

South Dakota State University. (n.d.). *Rubric template.* Retrieved December 30, 2002, from http://edweb.sdsu.edu/triton/july/rubrics/Rubric_Template.html

Teach-nology. (2002). Rubric, rubrics, teacher rubric makers. Retrieved December 30, 2002, from http://teachers.teach-nology.com/web_tools/rubrics/

The Landmark Project. (n.d.). *Rubric construction set.* Retrieved December 30, 2002, from http://landmark-project.com/classweb/rubrics/4x4rubric.html

Surveys (examples)

The International Consortium for the Advancement of Academic Publication. (2002, December 6). *Resources for methods in evaluation and social research.* Retrieved December 30, 2002, from http://gsociology.icaap.org/methods/

University of Southern Indiana Sociology Department. (2002). *Social research and statistical links.* Retrieved December 30, 2002, from http://www.usi.edu/libarts/socio/stats.htm

Professional Organizations (examples)

American Council on the Teaching of Foreign Languages. (2002). Retrieved December 30, 2002, from http://www.actfl.org/

Council for Exceptional Children. (2002, December 23). Retrieved December 30, 2002, from http://www.cec.sped.org/

International Reading Association. (2002). Retrieved December 30, 2002, from http://www.ira.org/

International Society for Technology in Education. (n.d.). Retrieved December 30, 2002, from http://www.iste.org/

National Art Education Association. (n.d.). Retrieved January 3, 2002, from http://www.naea-reston.org/

National Association for Music Education. (n.d.). Retrieved December 30, 2002, from http://www.menc.org/

National Association for the Education of Young Children. (n.d.). Retrieved December 30, 2002, from http://www.naeyc.org/

National Council for the Social Studies. (2002). Retrieved December 30, 2002, from http://www.ncss.org/

National Council of Teachers of English. (2002, November). Retrieved December 30, 2002, from http://www.ncte.org/

National Council of Teachers of Mathematics. (2002). Retrieved December 30, 2002, from http://www.nctm.org/

National Middle School Association. (n.d.). Retrieved December 30, 2002, from http://www.nmsa.org/

National Science Teachers Association. (2002). Retrieved December 30, 2002, from http://www.nsta.org/

Bibliography

American Association for the Advancement of Science. (1993). *Benchmarks for science literacy.* Retrieved December 30, 2002, from http://www.project2061.org/ (choose Benchmarks On-line).

ERIC Clearinghouse on Information and Technology. (2002). *ERIC database advanced search.* Retrieved December 30, 2002, from http://ericir.syr.edu/Eric/adv_search.shtml

Fogarty, R. (1995). *The mindful school: How to integrate the curricula awareness program.* Palatine, IL: IRI/Skylight Training and Publishing, Inc.

Freiberg, H. J., Driscoll, A., & Stetson, R. H. (1992). *Universal teaching strategies.* Boston, MA: Allyn and Bacon.

Gay, L. R., & Airasian, P. (2003). *Educational research: Competencies for analysis and applications* (7th ed.). Upper Saddle River, NJ: Pearson Education, Inc.

Hamilton County Department of Education. (2002, October 8). *Standards- grademarkers- benchmarks.* Retrieved December 30, 2002, from http://www.hcde.org/standards/stindex.html

Martin, D. B. (1999). *The portfolio planner.* Upper Saddle River, NJ: Prentice-Hall, Inc.

McAllister, D. A. (2002). *Teacher Preparation Academy.* Retrieved December 30, 2002, from http://cecasun.utc.edu/~tpa/tpa.html (also see http://cecasun.utc.edu/~tpa/mcallister/mcapage.html).

McMillan, J. H., & Schumacher, S. (2001). *Research in education* (5th ed.). New York, NY: Addison Wesley Longman, Inc.

Menges, R. J., & Weimer, M. (1996). *Teaching on solid ground: Using scholarship to improve practice.* San Francisco, CA: Jossey-Bass Inc.

Mills, G. E. (2003). *Action research: A guide for the teacher researcher* (2nd ed.). Upper Saddle River, NJ: Pearson Education, Inc.

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Mills, S. C., & Roblyer, M. D. (2003). *Technology tools for teachers: A Microsoft Office tutorial.* Upper Saddle River, NJ: Pearson Education, Inc.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Retrieved December 30, 2002, from http://standards.nctm.org/

National Research Council. (2000). *How people learn.* Washington, DC: National Academy Press. (see also http://www.nap.edu/readingroom/books/howpeople1/notice.html)

National Research Council. (1996). *National science education standards.* Retrieved December 30, 2002, from http://www.nap.edu/readingroom/books/nses/

Novak, J. D., & Gowin, D. B. (1984). *Learning how to learn.* New York, NY: Cambridge University Press.

Palloff, R. M., & Pratt, K. (2001). *Lessons from the cyberspace classroom: The realities of online teaching.* San Francisco, CA: Jossey-Bass Inc.

Poppe, B., McAllister, D., & Richardson, L. (1998). *Science on the web: Web activities using scientific data.* Boulder, CO: Space Environment Center/National Oceanic and Atmospheric Administration.

Poppe, B., McAllister, D., & Richardson, L. (1998). *Science on the web: Web activities using scientific data.* Retrieved December 30, 2002, from http://sec.noaa.gov/Activities/index.html

Provenzo, E. F., Jr. (2002). *The Internet and the World Wide Web for teachers.* Needham Heights, MA: Allyn & Bacon.

Roblyer, M. D. (2003). *Integrating educational technology into teaching* (3rd ed.). Upper Saddle River, NJ: Pearson Education, Inc.

Roblyer, M. D. (2003). *Starting out on the Internet: A learning journey for teachers* (2nd ed.). Upper Saddle River, NJ: Pearson Education, Inc.

Roblyer, M. D. (2003). *Integrating educational technology into teaching* (3rd ed.). Upper Saddle River, NJ: Pearson Education, Inc.

Tennessee Department of Education. (2002, May 30). *Curriculum frameworks.* Retrieved December 30, 2002, from http://www.state.tn.us/education/ci/cistandards.htm

Treffinger, D. J., Hohn, R. L., & Feldhusen, J. F. (1979). *Reach each you teach.* Buffalo, NY: D. O. K. Publishers, Inc.

Tuckman, B. W. (1999). *Conducting educational research* (5th ed.). Fort Worth, TX: Harcourt Brace & Company.

Items available in Lupton Library

Campbell, L., Campbell, B., & Dickinson, D. (1996). *Teaching and learning through multiple intelligences.* Needham Heights, MA: Allyn and Bacon.

Haladyna, T. M. (1997). *Writing test items to evaluate higher order thinking.* Boston, MA: Allyn and Bacon.

Krulik, S., & Rudnick, J. A. (1995). *The new sourcebook for teaching reasoning and problem solving in elementary schools.* Boston, MA: Allyn and Bacon.

Ross, S. M., & Morrison, G. R. (1995). *Getting started in instructional technology research.* Washington, DC: Association for Educational Communications and Technology.

Silberman, M. L. (1996). *Active learning: 101 strategies to teach any subject.* Boston, MA: Allyn and Bacon.

Wilson, B. G. (Ed.). (1996). *Constructivist learning environment: Case studies in instructional design.* Englewood Cliffs, NJ: Educational Technology Publications.

As part of my 2002-2003 Teaching, Learning, and Technology Faculty Fellow award (one of six on campus), I am investigating the effectiveness of using Blackboard as the communication device for Educ 590. Blackboard was used during fall semester 2002, as a trial-run of the process; it was not used during spring semester 2002. The following section of text is from my application:

Describe a **teaching or learning** topic you'd like to learn about and research during your TLT Faculty Fellow year. This topic does not necessarily need to include technology and should NOT be focused solely on learning a particular technology tool. Outline how knowledge in this area will change your teaching and learning and how further knowledge in this area will help your students and your discipline. Also include ways in which you will use knowledge in the topic area to help other UTC faculty improve their teaching and student learning.

Topic: Using Blackboard to Manage Action Research Projects
Scholarship, in the form of research, is assuming a more prominent place in the work of UTC faculty. With the donation of the Lupton Renaissance Funds, the Chancellor is urging requests that propose to obtain materials and promote expertise "that would be essential" to elevate UTC to a "national level of excellence in discovery, creativity, instruction, and service," as with the "mouse house" at Oak Ridge. The Dean has told faculty that more research must be done. The Graduate School regularly requests information on projects and programs in which graduate students participate.

As part of my teaching load, I am working with the M.Ed. teacher licensure students on their Education 590 Culminating Experience as they each carry out an action research project during the student teaching experience in a local Professional Development School. Projects submitted during the spring semester have been revised, and the collection will be submitted to ERIC for publication.

If selected as a Faculty Fellow, I plan to further develop and refine the requirements for this course, transferring the course to Blackboard so that Blackboard is used as the primary medium of communication. With an awareness of the wealth of information available, strategies for developing a better sense of information literacy within the education discipline, and the proposed research area, will be presented for student use as action research projects are written and implemented. Outcomes from the Association of College and Research Libraries' (2000) *Information literacy competency standards for higher education* will be interwoven, as appropriate for the course.

I believe I possess the appropriate knowledge and skills in education and technology to be successful as a Faculty Fellow, both in the work I propose to undertake with regard to my teaching, and as a facilitator for the campus and extended community. Selection as a Faculty Fellow would present the opportunity for me to make substantial contributions to the university in the areas of teaching, service, and scholarship. Knowledge gained from this project will be made available for use by other faculty and students as they work on individual or collaborative action research projects. Thank you for your consideration.

Reference:

Association of College and Research Libraries. (2000). *Information literacy competency standards for higher education*. Retrieved 05/21/02, from http://www.ala.org/acrl/ilstandardlo.html

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“TO TRACK OR UNTRACK....
THAT IS THE QUESTION”

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Introduction

Yearly, administration is given a new set of students with which to work. And every year decisions must be made regarding the student body. Will teachers operate as a team? If so, how large of a team? Will students stay within the same small group or will they rotate schedules so as to have different class makeup in each one? For years, many have solved this problem by tracking students by ability into different classes. There are usually three main groups: high, average, and low. Despite good intentions, this method has had negative side effects, which outweigh the positive qualities. Those students in the low group are left behind and neglected. The intelligence gap only increases when students are tracked academically. This issue is on the forefront of education today. It is especially a "hot" issue in middle school curriculum. Many schools chose to continue tracking because it is the easy way to go. Other schools desire to untrack but do not know how best to go about it. This topic was chosen to discover some of the best methods of untracking a school that is currently tracked.

The middle school under study is a relatively new school which continues in the practice of tracking students according to their academic abilities. I taught four classes of sixth grade mathematics. The first group was the "inclusion" class. These students never had classes with anyone else. They stayed in a self-contained unit all day long. The second group was the "advanced" class. These were the "bright" students. For the most part, they had the same classes throughout the day. My third and fourth groups were considered somewhere in the middle.

Review of Literature

The majority of current literature argues for detracking in the school systems. It is a rare article that will still argue the benefits of ability-based grouping. Cathy Dean wrote such an article. She likens the academic world to the sports world. No one would question having a varsity team and a junior varsity team. People would question if players on a j.v. team played against other teams of varsity level skill. She suggests academic skill level is no different. Students will compete best when in similar ability levels.

Ms. Dean continues by saying that a heterogeneous model is only successful when teachers can develop effective classroom instruction to the different levels and this is rarely successful. Most often, teachers simply teach to the lowest level leaving the gifted students out on their own. She further counters the idea that students would interact with all kinds of people by suggesting a homogenous grouping allows students to grow in a closer knit community. Instead of the possibility of interacting with 200 other classmates, ability tracking limits this to a mere 80 to 100 students. "Clearly, if it is better to have many classes with the same group of students, ability based grouping is the best choice for all students, gifted or not" (Dean, 2000, ¶ 4).

Another facet of homogenous grouping is the potential of psychological damage to those who are in the lower tracks. Ms. Dean suggests to the contrary that students perform better because other student's abilities match their own and they realize their ideas are worthwhile. She quotes educator Richard Bayer: "'I do not find that children … suffer psychologically because of tracking itself. Indeed, social status is more frequently tied to sports, clothing, being cool, early sexual development, being loud, etc.'" (Dean, 2000, ¶ 6; February, 17, 1995, Prodigy, Education BB).

Ms. Dean would ask the reader to think about what kind of students we want to produce. Do we want all one mold or cookie-cutter students? If so, then take out tracking in the schools.

"Unless [gifted students] are freed from the restraints of mediocre classrooms and given the chance to excel they will never be truly able to achieve up to their potential" (Dean, 2000, ¶ 10).

The majority of the literature, however, is to the contrary ands argues that most children are being left behind when ability-based tracking is implemented. Susan Olsen (1997) offers a short testimony to the benefits of detracking. She and several colleagues started a school in their state prison. Ms. Olsen started with few supplies and simply improvised with her students. "The response from my prison students was remarkable. The light bulbs went on; the sparks flew … Much to our delight, our students scored at a pass rate of 80 percent—the highest in the state" (Olsen, 1997, ¶ 3). She attributes her success to her stupidity. She didn't know that prison inmates "couldn't learn." To compensate for the lower-ability students, she gives them extra support so they can stay in the classes. "If correctional educators can take students who 'fell through the cracks' and enable them to become successful through high expectations, so can public school teachers. Detracking public schools would push more students toward success and away from our barbed-wire fences" (Olsen, 1997, ¶ 11).

Anne Wheelock is one of the forefront authors on untracking. She has written articles, as well as a book entitled, *Crossing the Tracks: How 'Untracking' Can Save America's Schools* (1992a). Ms. Wheelock provides a more comprehensive definition of tracking. "Tracking involves the categorizing of students according to particular measures of intelligence into distinct groups for purposes of teaching and learning. Once sorted and classified, students are provided with curriculum and instruction deemed suited to their ability and matched to spoken or unspoken assessments of each student's future" (Wheelock, 1992a).

Many schools continue with tracking for reasons of convenience, tradition or lack of suitable alternatives. However, given the negative outcomes, it is necessary to overcome comfort in order to give all students a chance to learn.

Ms. Wheelock is quick to point out that the problems far outweigh any benefits. First of all, tracking does not result in equal distribution of effective education for all students. Those students that face the greatest struggles in school often are given the weakened curriculum and often the weak educators. One researcher found that the majority of teachers who have taught less than 5 years are teaching remedial, vocational, and general mathematics sections where only a few are teaching pre-algebra and algebra.

The differences in lower grades become huge chasms as students continue in their schooling. Grade retention is similarly harmful. She cites research that shows repeating a grade at any level rarely promotes achievement and frequently contributes to student disengagement. This is particularly contradictory to the democratic values of our American schools. Similar to Lincoln's quote on government, schools should have the same philosophy:

> "Most governments have been based on the denial of equal rights; ours began by affirming those rights. They said, some men are too ignorant, and vicious, to share in government. Possibly so, said we; and, by your system, you would always keep them ignorant and vicious. We propose to give all a chance; and we expected the weak to grow stronger, the ignorant, wiser; and all better and happier together." (Wheelock, 1992a)

Wheelock points out the incongruency of tracking middle school students. Students at this level develop in all different manners and speeds. "Students enrolled in pre-algebra may still enjoy playing with Legos or having a stuffed toy in bed with them, and students who lack confidence in basic academic skills may, nonetheless, be developing an increasingly sophisticated social awareness" (Wheelock, 1992a). In other words, even if students are grouped at the beginning of the year, within a few short months, those groupings are no longer valid.

Ms. Wheelock reminds the reader that intelligence is not a fixed quantity, but rather one that is dependent on learning environments. When students are in a variety of settings, their intelligence grows as a result of interacting with different strengths. "Schools and classrooms which include diverse learners and employ the instruction and curriculum that makes mixed-ability grouping work represent such settings" (Wheelock, 1992a).

When schools untrack, they must also have a plan of action. To untrack is not enough in and of itself; the underlying philosophies must change, making alternatives to tracking profitable. Ms. Wheelock wrote an article for *Educational Leadership,* entitled "The Case for Untracking," suggesting such changes (1992b). The first of nine is the belief that all students can learn. Untracking involves a commitment to all students instead of just the top students. A second feature is the belief that change is a process. She writes, "While at first blush untracking focuses primarily on the regrouping of students, success is unlikely without reforms in curriculum, instruction, assessment, and counseling that complement the new grouping arrangements" (Wheelock, 1992b). Along with this belief is commitment to "leveling up" rather than "watering down" the curriculum. The third component is to hold high expectations for all students. Schools must find some way to encourage high expectations, even with their lowest students. This can be accomplished in many creative ways such as duplicate periods in a math class. "Educators … act on the belief that persistent effort rather than inborn ability is a precursor to success in life and the basis for lifelong learning" (Wheelock, 1992b).

A fourth element is the partnership between leaders and teachers. Principals and teachers must be working together on the same page. Principals need to make it safe for teachers to take risks with their kids as they learn how to work in untracked classrooms. Principals can also encourage and train their teachers by sending them to professional development to view how other schools are implementing untracking. A fifth ingredient is the value of parental involvement. Many parents are hesitant to untrack their students, especially if they are in the upper tier. They feel their students will no longer be challenged in school. Wheelock suggests a phase-in method so as to allow parents to accept the change gradually. She also suggests inviting parents to attend classes and informing them, as much as possible, about the new curriculum. Further support can come from district and state-level policies. In the sixth component, Wheelock shows incentives that some districts are willing to give in order to untrack schools. For example, "The Massachusetts Department of Education (1990) has not only issued a policy advisory and sponsored professional development programs to encourage alternatives to ability grouping, but has tied discretionary dropout prevention and remedial grant funding to untracking" (Wheelock, 1992b).

The last three components have been previously mentioned but are here stated explicitly. The seventh one is that untracking should be a multi-year plan. Take time in order to do it well. She suggests a timetable spanning 3 to 7 years. The eighth element is to have purposeful professional development. This includes untracking, new curriculum, and other classroom techniques. Finally, Wheelock suggests that there must be a phase-in process. Some schools merge the bottom levels in with the other subjects allowing extra time for tutoring. Others change subject by subject until all are untracked. Another option is to untrack a team at a time, or even a grade at a time, starting at the lowest grade level and moving up.

Ms. Wheelock answers the question of whether it is worth it or not. She answers by saying that achievement is up for both low and average students, while unchanged, or even improved, for higher students. A teacher from Iowa states, "I've never worked so hard being creative, but I'm also convinced that I'm teaching better" and a principal from Washington writes, "What I've stopped seeing is very talented, bright children feeling they're not worth a bit of salt because they haven't made it into an elitist program for students labeled 'gifted'. I'm seeing all kids realize there are lots of kids who can contribute to learning even when what they contribute is different from the.m" Anne Wheelock concludes, "This is excellence. This is equity" (Wheelock, 1992b).

In an article entitled "Is Ability Grouping the Way to Go—Or Should it Go Away?," Gary Hopkins (2003) cites research done by Robert Slavin which comprehensively reviewed grouping practices. He suggests that some forms of grouping are useful and can increase student achievement. He developed five grouping plans. The first grouping is of students as a class by ability, which does not improve achievement. However, students that are grouped for one or two subjects often have a higher rate of achievement. Grouping just for reading classes (a.k.a. The Joplin Plan) is also useful for improving reading achievement. A fourth method is to use nongraded instruction that groups students according to ability, not age, and allows students to progress at their own rates. This method can also result in improved achievement. A fifth and common approach is to use in-class grouping where teachers break students into two or three ability-based groups for particular instruction.

Hopkins also gives some of the more devastating effects of tracking. Often, teachers end up confusing students' pace of learning with their capacity to learn. Teachers also create in their minds different expectations for their different groups of students, associating them as a particular type of students. Students, once grouped, often stay at that level for their entire school career without being reevaluated. This results in an exaggerated gap between achievement and level. Despite all positive intents of ability grouping, tracking is overall harmful and detrimental to students.

The National Association of School Psychologists (NASP) released a position statement regarding ability grouping (2002). Tracking is not consistent with the democratic belief that all children can learn. NASP cites extensive research as to the negative effects. Among these are the facts that students with lower ability achieve less than in mixed ability grouping; tracking reduces the likelihood that students in lower tracks will choose college preparatory classes; and tracking students reduces self-esteem, especially regarding their own academic competence.

NASP recognizes that simply grouping students heterogeneously will not increase improvement. "'Watering down' the curriculum or 'teaching to the middle' will create disadvantages for able students and should be avoided" (NASP, 2002, ¶ 3). They understand that classes require innovative teaching approaches that include peer tutors, cooperative learning groups, team teaching, and instruction in higher order thinking and problem solving skills. Finally, NASP is clear that developing alternatives to tracking is not done overnight but requires patience and much careful planning.

The amount of research and articles about tracking is staggering. However, the majority of research and opinion point to the detrimental effects of tracking and advocate untracking with a purpose in all schools.

Data Collection and Results

A pre-test was given to four classes of sixth-grade students covering basic concepts of percent, ratio, and proportion. Instead of using names for identification, birth dates were used. This enabled students to take the test with less test anxiety, as well as ensure privacy for the individual. After 3 weeks of instruction on the material, a post-test was given following the same format. The pre-test and post-test were compared, most notably in improvement points. Students with only one test grade were not included in class averages.

The hypothesis was that the inclusion class (1st period) would have the most improvement in their scores because they started out very low and had a lot more room to grow. The 3rd period was the gifted class; the 5th and 7th period classes were middle level classes. In actuality, the class I had least expected improvement from increased by an average of 10 more points than the other classes. The 1st, 3rd, and 7th periods increased 23.53, 27.74, and 26.31 points respectively. The 5th period, however, increased an average of 37.57 points per person (See Figure 1).

	Average Pretest	Average Posttest	Average Improvement Points
1st	22.4	45.93	23.53
3rd	53.13	80.87	27.74
5th	29.29	66.86	37.57
7th	40.62	66.92	26.31

Figure 1. Class averages for pre- and post-tests.

The graph indicates that, while the 7th period class started out higher than the 5th period class, the 5th period class made significant gains and came out almost equal with the 7th period class (See Figure 2). In all four classes, the average improvement per person was 28.70 points. There were only two instances where a student regressed – one by 3 points and the other by 19 points. The largest improvement was 70 points by a student in the 5th period class.

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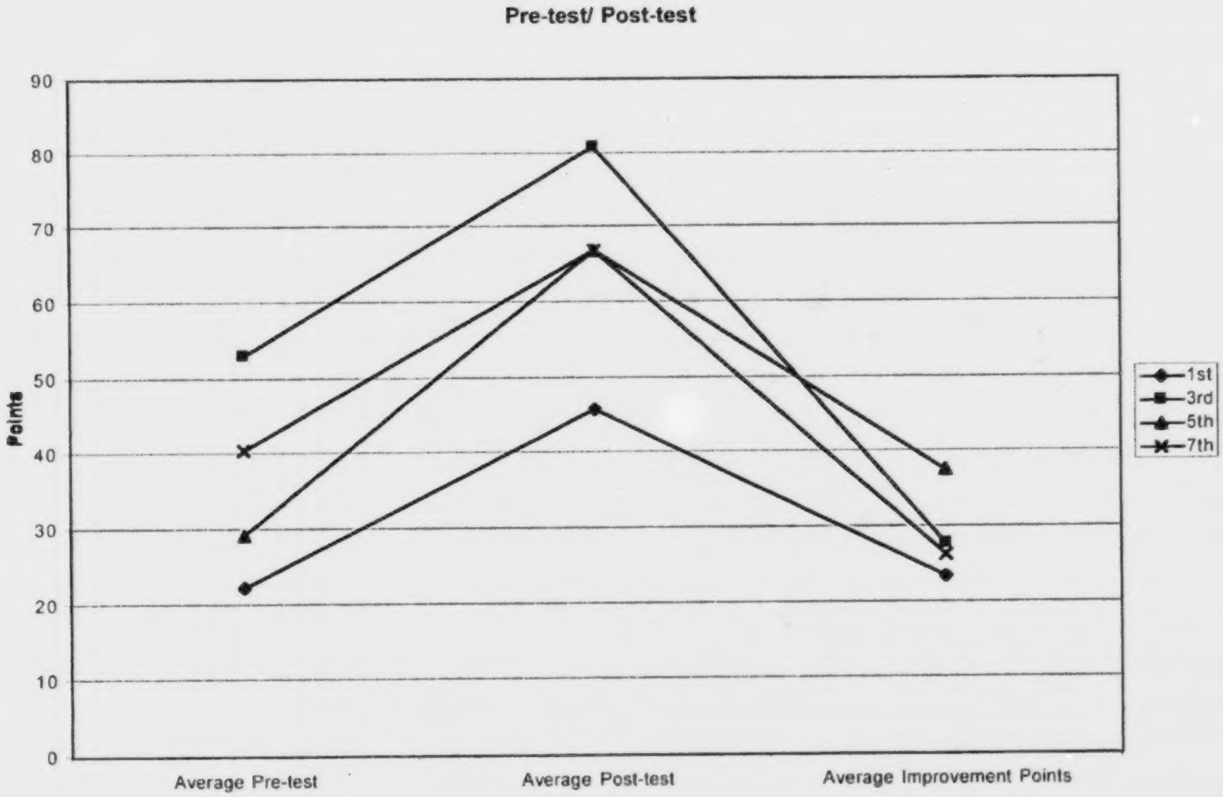

Figure 2. Pre-test/post-test results by class.

While the 1st period class did work hard, they did not prove the hypothesis that they would see the largest improvement.

Conclusions and Recommendations

Advocates of tracking would suggest that gifted students would have the opportunity to learn much better if grouped together and inclusion students would fare better if they are together, as well. Results from this research indicate otherwise. The improvement of 1st and 3rd period classes differed by only 4 points per student. In fact, the gifted students were the most difficult class to teach, resisting learning. They were labeled as "smart," and they knew it and acted upon it. They demanded different treatment than other students were given. On the other hand, the inclusion students believed the label that they were "dumb" students. They were consciously aware that they never saw anyone else on their team, but were kept in a small group the whole day.

I had the opportunity to see, played out before my eyes, the detrimental effects of tracking. As a student teacher, my lessons were tailored to meet the specific needs of each classroom, yet this did not make up for the holes left by tracking. The students left in the middle brackets were, in fact, the best learners, with the 5th period class demonstrating this through the pre-test/post-test results.

My recommendation would be for these classes to untrack. Teachers must be willing to creatively think outside of their normal strategies and try innovative methods for increasing student achievement. Much would be gained to have inclusion students believing they can accomplish work and much would be gained by having "gifted" students grasp learning in a whole new way.

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________________Birthdate

Express each ratio as a fraction in simplest form:

1. 3 blue sweaters out of 12 sweaters

2. 15 flutes in an 80-member band

Solve these proportions:

3. $\frac{3}{7} = \frac{9}{x}$

4. $\frac{3}{9} = \frac{x}{6}$

5. You're reading a scale drawing of your bedroom. The scale is 1/2 inch = 1 foot. What are the real measurements if the drawing indicates:

	Length		**Width**	
Desk	1 1/2 in.		3/4 in.	
Bed	3 1/4 in.		1 1/4 in.	
Dresser	2 1/8 in.		1 in.	

6. Fill in the chart with the missing information.

Fraction	**Decimal**	**Percent**
1/4		
	0.60	
3/5		
		72%

7. What is 50% of $360.00?

8. What is 25% of $484.00?

PROVIDING URBAN STUDENTS WITH THE MOTIVATION TO SUCCEED IN SCHOOL

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Introduction

It is no secret that urban students have different needs than suburban students. They often have concerns and issues that they deal with on a daily basis that most suburban students could never even imagine having. For instance, little Jenny's biggest concern may be what style of prom dress to buy this year; whereas, little Tamika may not know where her next meal is coming from or if she will be safe walking home today. It is no doubt that fears and concerns of this nature carry over into the classroom. It is highly understandable that urban kids have "bigger" problems to deal with than whether or not they completed last night's math homework.

Most of these urban students are fully aware that the one key to getting out of poverty and bettering themselves is to acquire a good education. Many of them are so concerned with trying to meet their daily needs of survival and security, though, that schoolwork is the last thing on their mind once they leave the building each day. Also, many of them lack self-esteem and confidence. Urban students may put on a good show, but deep down, many of them are still really just scared children.

Often it seems that educators become intimidated by the daunting task of teaching these students. Some teachers lose sight of the fact that urban students are children who need love as much, if not more, than the next child. They also need attention and discipline. For most of these students, motivation does not naturally come from the inside and it is our job as educators to teach it to them, so that they can gain confidence in their ability to achieve. If educators can provide these students with a true feeling of self-worth and pride, they will be opening up doors that these students may have never even known existed and helping them to create a better life for themselves in the future. It all truly comes down to motivation and self-confidence.

Review of Literature

Over the past several years, a high interest in meeting the needs of urban students has developed, especially with the new standards of school and teacher accountability that are based solely on standardized tests. These are the same standardized tests on which students in urban schools consistently do poorly. It is no longer acceptable to allow urban students to perform poorly, and many researchers and instructors have taken it upon themselves to discover how to help these students pull their grades up. The two methods for achieving this that are discussed most often in the literature are instilling self-confidence in our students and teaching them to be self-motivated.

In their article, "Social Reconstructionism for Urban Students," Reed and Davis (1999) discuss a concept called social reconstructionism. In the classroom, this concept deals with helping "…students relate academic and personal goals to world, national and local purposes" (Reed and Davis, 1999, p. 292). The idea behind social reconstructionism is to get urban students to take an active role in improving their communities and environments, which will provide them with a sense of self-worth and the knowledge that they can make a difference.

Jacqueline Irvine also discusses instilling self-confidence in students to help bolster motivation in her article, "The Education of Children Whose Nightmares Come Both Day and Night" (2000). She begins by discussing four explanations for the low achievement of urban students, including socioeconomic, sociopathological, genetic, and cultural. She discounts genetic immediately, but states that the other three are contributing factors. She then begins her discussion of how teachers can strive to overcome these obstacles and help our urban students achieve. Irvine discusses her work in CULTURES, a professional development center she has been involved in that has enrolled "…more than 150 teachers in five culturally diverse school districts in the Atlanta metropolitan area" (Irvine, 2000, p. 249). Irvine then goes into describing what she has found to be key characteristics that successful educators in these urban schools have in common.

The first characteristic Irvine discusses is that of teaching being about "caring relationships." Successful teachers, she states, "…turn schoolhouses into school homes where the three Cs – Care, Concern, and Connection – are as important as the three R's" (Irvine, 2000, p. 249). When students know that their teachers really care about them succeeding, they will work harder to do so. Another characteristic Irvine discusses is that of teachers truly believing they can make a difference with their students. She also discusses teaching being a calling, not just a career, and being a compassionate, but strong, disciplinarian.

In their article, "Networking: Addressing Urban Students' Self-Esteem," Tobias and Turner (1997) discuss a community-based project that "…focuses on the strengths of young people rather than their problems" (Tobias & Turner, 1997, p. 33). This program is comprised of what is known as the "Four-Part Meeting." There are four key phases on which this program/meeting focuses. The first, "self-affirmation," attempts to teach children to be proud and realize that it is okay to celebrate when they succeed. It teaches them to have a positive attitude about themselves. The second phase is "self-concern." The authors hold that it is important for students to express their worries and concerns and know that it is normal to get angry and frustrated, at times. The third phase in this plan is "self-improvement." This is the phase where students put together an action plan for achieving their goals. This allows them to look at where they want to go and create a doable way to get there. This provides students with a sense of empowerment that their futures really are in their hands. The final phase in this plan is "self-reflection." This is a short period of time where students learn that silence is not something to fear, but something to embrace. The authors make a very good point when they state, "For those young people who are exposed to a continuous din of television, sirens, music, earphones, arguing and other noise, silence can be frightening because it is unfamiliar" (Tobias & Turner, 1997, p. 34). When we, as teachers, get frustrated with the continual noise levels in urban schools, we must understand that noise is a way of life for these students and that it is up to us to teach them that silence can be a good and comforting thing (Tobias & Turner, 1997).

Schools that have implemented this program rave over its successfulness. The New York City Board of Education reported a three-point increase in math scores within "networking" schools during the 1995-1996 school year as compared to the only one-point increase in the control schools. Also, a 1991 study showed that "networking" students had significantly higher language arts and math scores than did their non-networking counterparts. It is not only test scores that are affected by this program, but also student attitudes and behavior, as well. One principal stated, "Right before my eyes and ears, the children began to replace outright rudeness with politeness, and failures with acceptable grades" (Turner & Tobias, 1997, p. 37). Empowering students and providing them with some confidence appears to make all the difference in motivating students to change their attitudes and work harder than they ever have before to achieve their goals (Tobias &Turner, 1997).

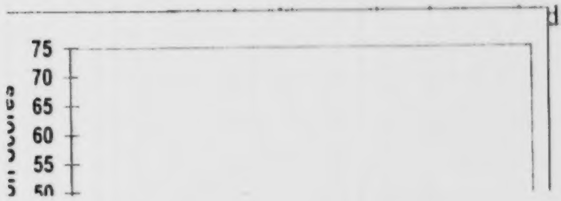
The importance of keeping our students engaged to keep them interested, and motivate them to learn, is a hot topic in education at the moment. Taylor, Kallingal, Walker, and Yekovich discuss providing students a technology-rich environment to do just that in their article, "Multimedia Literacy Activity: Motivating and Engaging Young Urban Learners" (Taylor et al., 1999, p. 1). Researchers at Temple University created a program they refer to as TRALE (Technology-Rich Authentic Learning Environments), that "…identifies and defines essential characteristics of environments that support young children's engaged learning" (Taylor et al., 1999, p. 1). The TRALE project creates learning experiences that implement computer-based technology beginning in elementary school classrooms. In these classrooms, students were taught to use computer programs, such as *HyperStudio,* independently. Their response to the program was measured to see if they, first of all, could learn to use it independently, and also to see if their motivation to learn increased with this technology available. The results of this program were very promising. Students who did not perform well on reading and writing activities, and, therefore, did not respond to paper and pencil work, showed great enthusiasm when involved in the technology-based learning. The act of doing something different, that encompassed more than just reading and writing, really got the students interested and engaged. In this program, the "students [were] enthusiastically engaged with the computer and were not frustrated by their lack of skill" (Taylor et al., 1999, p. 4). These students were instilled with a sense of achievement, and, therefore, gained confidence in their academic abilities, where, before, they had not seen themselves as successful.

We know from the literature that it is vital to instill self-confidence and motivation in our students to help them succeed, but what do students say it is that really makes them want to work harder? The overwhelming response is "good teachers." In the article, "What Urban Students Say About Good Teaching," by Corbett and Wilson (2002), urban students report what, in their opinions, make good teachers. When asked this very question, "What makes a good teacher?," urban students from Philadelphia repeatedly provided the same six responses. The first response was "Good teachers push students." The apathetic attitude that many students exhibit masks the true desire to learn and achieve that many of these students actually possess. Students reported liking teachers who refused to accept excuses and pushed them to do their work and try hard. The second response discussed in this article was, "Good teachers maintain order." Many students interviewed complained about classes that were disorderly. In a disorderly class, they said, "The kids don't do the work. The teacher is hollering and screaming, 'Do your work and sit down!' This makes the ones who want to work go slower. It makes your grade sink down. It just messes it up for you" (Corbett & Wilson, 2002). Students also say that good teachers are willing to help, vary classroom activities, explain until everyone understands, and try to understand students. If we, as teachers, want to motivate our students, it is important that we know what it is they need from us. When they come right out and tell us what it is that they need from us, we have no excuse not to give it to them (Corbett & Wilson, 2002).

Data Collection and Results

As was stated previously, due to accountability issues, teachers now must find

dized test scores of urban students. Until one looks at



the scores of urban students as compared with suburban students, one may not realize the huge discrepancy in grades. The 2002 TCAP Achievement Test Results speak for themselves.

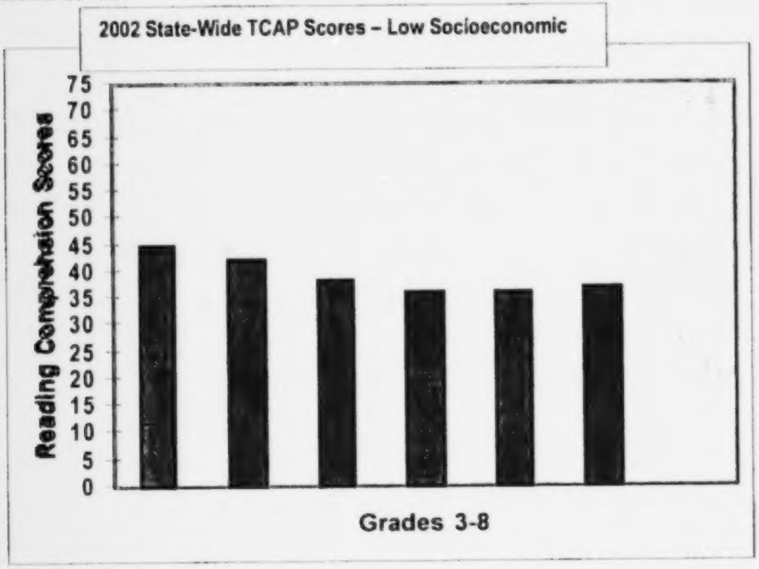


Figure 1. 2002 state-wide TCAP scores – low socioeconomic.

Below is a chart showing the average grade-level reading comprehension scores for low socioeconomic students, beginning with grade 3 and ending with grade 8 (see Figure 1). The chart below features the scores from the same test administered to non-low

2002 State-Wide TCAP Scores – Not Low Socioeconomic

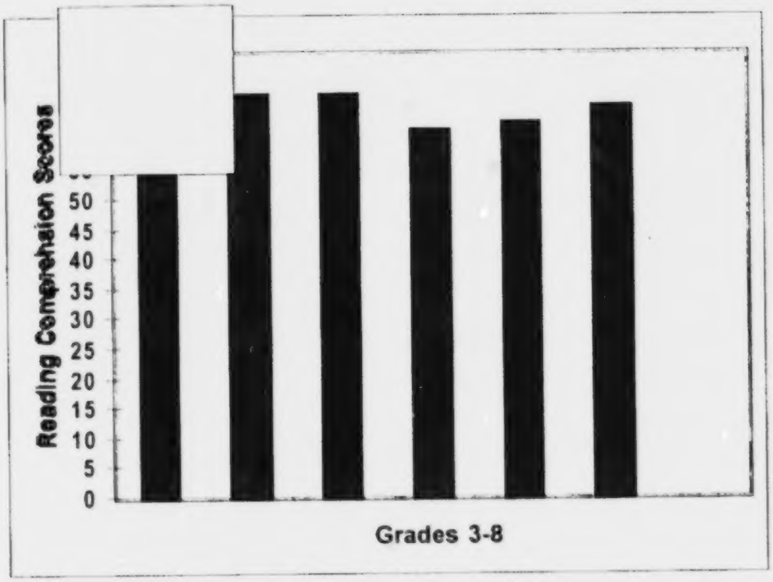


Figure 2. 2002 state-wide TCAP scores – not low socioeconomic.

Math, science and social studies scores all also exhibit the same phenomena. The mean TCAP math comprehension score for non-low socioeconomic students in grades 3-8 in 2002 was 69.17, while the mean score for low-socioeconomic students was 44.33. The mean science score for non-low socioeconomic students, grades 3-8, was 60.83, while the low-socioeconomic mean was 35.5. The mean social studies score for non-low socioeconomic students, grades 3-8, was 62.17, while the low-socioeconomic mean was 37. These results are obvious and disturbing. The scores for the low-socioeconomic students in Tennessee were significantly lower then the non-low socioeconomic students. The scores speak so loudly that educators need to be focusing on how to improve these scores. Research shows that the best way to accomplish this is to teach students to believe in themselves and to become intrinsically motivated to do well.

Conclusions and Recommendations

It is apparent by looking at the above scores that something must be done to help these students achieve. While standardized tests may not be the best indicator of learning, it is all we really have at this time, and it is the method by which educators are held accountable for their students' learning. The literature clearly states that it is very possible for urban students to succeed, and that many of them truly want to succeed. The literature also shows that it is up to educators to teach these students how to succeed. Many educators are not aware of how to do this. This is where new teacher training and professional development can assist. Many universities require students to student teach in an urban school, but most of these universities do not do anything to prepare their students for entering into this kind of environment. Future teachers need to be informed of the challenges that they will be faced with in an urban school, the issues students in these schools deal with, and how to address the students and their issues and concerns successfully. Urban schools are a different culture altogether, and to teach successfully in one, it is important to first understand where the students are coming from and how to gain their respect and reach them. Student teachers would have much more success in these urban schools if they had more preparation before going into them. There should also be opportunities for current teachers in urban settings to participate in professional development that deals with teaching in urban schools. Since keeping students in these schools motivated and engaged is the best way to achieve success, teachers need to have the opportunity to keep up with new teaching techniques to use in the classroom, especially technology-based teaching techniques, since it has been shown that urban students respond very positively to technology.

Reaching and motivating urban students is a very important topic of educational research, at this point in time. Much more research is sure to be done over the years, as more schools implement programs such as "networking," and other programs to aid and motivate urban students. The children are the future of the world; not just privileged and suburban children, but all children. It is our responsibility as educators to ensure that all students have the opportunity to receive a high quality education and to prepare them to be successful adults in the future.

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UNDERSTANDING THE STRUCTURE OF DNA

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Introduction

This project was designed with the objective of determining the most effective strategy to secure the highest level of student learning in the area of understanding the structure of DNA. This subject area would be built directly on previously learned knowledge in the area of basic genetics heredity. The demographic being examined was sophomores in an average high school Biology I setting. This broad subject area was identified within the Gateway Biology Examination as a primary area of evaluated knowledge. Due to State of Tennessee mandated passage of this examination to secure high school graduation, this subject area was determined to be critical in effective teaching of this unit.

With this clear focus in mind, a pre- and post-testing process was designed to assess retained student knowledge in the basic principles of genetics and heredity and the basics of understanding the structure of DNA principles. Through this testing process, the teacher could determine the most effective starting point and agenda in the instruction of this material to secure maximum efficiency and student success. Through this pre-teaching testing process, the effectiveness of visual classroom instruction and "hands-on" student activities could be carefully examined, and was evaluated as the most effective teaching strategy in the presentation of this material.

Review of Literature

In order to carefully and correctly weigh the effectiveness of very visual classroom instruction and "hands-on" activities, it was important to conduct a survey of relevant opinions and evidence. The vast majority of literature revolved around scientific subject areas and specifically genetics and heredity Issues. A popular message that surfaced in many articles was the inclusion of central classroom themes throughout teaching units. These themes included visual direct instruction techniques coupled with mental subject mapping and "hands-on" laboratories and activities.

Offner (1992) relayed a success anecdote that revolved around use of the unifying classroom theme of "how chromosomes determine what we are." This use of theme was shown to create a logical coherent sequence of lessons on topics such as proper proteins, enzymes, and amino acid function, while linking them with laboratory exercises revolving around examples of real-life disease that can result (Offner, 1992).

Dass (1997) made a related observation in a group of high school students with a study exploring centralized themes revolving around contemporary bioethical themes. It was found that the science and technology demands of today's science education curriculums require a more organized comprehension and personal experience (Dass, 1997).

Atkins and Roderick (1991) authored a successful unit and accompanying activity series that introduced and utilized continuously the theme of independent assortment of alleles throughout the units on gametogenesis and the sequential patterns of heredity. Tolman (1982) published an earlier study where he had taken the Adkins & Roderick premise and further developed into an entirely new sequence to teach the accepted high school genetics curriculum. The Tolman study used curriculum rearrangement to successfully address problem solving strategies in high school situations.

Tsai (1999) described an in-depth, and potentially significant, finding in a study that examined the relationship between the scientific epistemological views (SEVs) and the succession of their overall learning through hands-on laboratory activities. Students that had SEVs developed a tendency to negotiate the meaning of science experiments and demonstrated SEVs much more in line with empiricist views of science Tsai (1999).

These literary examples included the situations of direct instruction teaching techniques coupled with visual mental subject mapping and "hands-on" laboratories and activities that I found as evidence to support my pre- and post-testing theory.

Data Collection and Results

I. Findings

Careful review of the results from both the pre-test and the post-test revealed dramatic findings. The average score for the pre-test was 30.5 out of a possible 100 points, while the average score for the post-test was 87.4 out of the same 100 points. These results clearly demonstrated that the students had very little prior knowledge or recall of the subject matter, or a great deal of time had passed since their last exposure to it. It was revealed through discussion with students that some recalled limited discussion of the subject in 7th grade, while others could not recall any previous exposure. It was very clear that detailed teaching of the material made a significant increase in knowledge of the subject matter for all students. The pre-test is contained in Appendix A; the post-test is contained in Appendix B. Figures 1-4 are contained in Appendix C.

II. Adjustments

Based upon the results of both tests, understanding the structure of DNA was an area of very little student knowledge. There was very little recognition of the basic vocabulary or concepts associated with this topic. There was even less knowledge of the scientific history detailing this topic. It became very clear that a series of lessons would have to be designed that started from a very basic point and progressed through very visual and "hands-on" lessons and activities. The history of DNA was discussed first, with clear linkage to the previous lessons on Mendelian genetics and basic heredity patterns. This lesson was followed by unhurried discussions of the nucleotides and structure of DNA. Activities were designed that required students to manipulate models of the above mentioned items to establish concrete knowledge.

III. Other Uses for Pre-test Results

Since this topic is heavily included on the Biology Gateway Examination, the results were also used to help determine the amount of time to be spent on the topic, as a whole, to clearly solidify the basic understanding. It was determined that unhurried practice in hands-on visual activities would be crucial in establishing this strong basic understanding.

IV. Implications of the Post-Test Findings

Careful review of the post–test findings revealed a significant increase in knowledge in the area of understanding the structure of DNA. The average score on the post-test increased to 87.4 out of 100. There was only one score of 64, while all others were well above 70. Those students who scored on the lower end of the passing scale were often absent, negligent in completing assignments, or admittedly failed to study for the post-test. It appeared that the decisions to incorporate visual hands-on activities were the correct ones and resulted in success.

V. Value of the pre-test and Post-Test

A. Students

Students were very honest about their lack of exposure or recall of the subject matter. Many voiced their alarm at the great length of time that had lapsed since their last exposure to the subject matter. They stated that the pre-test and post-test process would help them determine how much time they would personally need to spend on studying this topic to be successful in it.

B. Teacher

The teacher found the pre-test and post-test process to be invaluable to the teaching of this topic. Pre-test results were very clear in showing the general lack of previous knowledge in the area of Understanding the Structure of DNA. Without the informative results revealed in this pre-test, the entire focus and sequence of this series of lessons could have been totally off and could have completely failed to properly instruct this material to the students. The post-test results clearly demonstrated that the decisions to structure the unit in a sequential and orderly manner was, in fact, a successful decision. The students clearly benefited from the carefully designed lesson plans.

Conclusions

The pre-test and post-test process was a very successful tool in determining the previous knowledge of students in a certain subject area and in designing a specific lesson plan sequence to address the level of knowledge in the appropriate manner. It was also effective in assessing the amount of knowledge the student gained after the unit with the post-test. This process would be a very useful tool for assessing previous student knowledge in any subject area. Teachers who use a pre-test and post-test process will find that it is easy to design appropriate lesson plans, and it allows for maximum benefit for both student and teacher.

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Appendix A

Understanding the Structure of DNA – Pre-test

Name: ________________ **Date:** ______________ **Period:** ___________

1. A ______________ is the basic unit or building block of the DNA double strand.

2. ______________, ______________ and ________________ are the three parts of a nucleotide.

3. ________________ and ________________ are two types of bases in the DNA molecule.

Match the following definitions with the correct term.

4.	_______ A base that pairs only with thymine	a. quanine
5.	_______ A base that pairs only with guanine	b. thymine
6.	_______ A base that pairs only with cytosine	c. adenine
7.	_______ A base that pairs only with adenine	d. cytosine

8. The scientists that explained the double helix shape of DNA and received a Nobel Prize in 1962 were named _____________ and _____________.

9. Under the following list of bases, write the correct base sequence to pair with it.

T A T C G G T C A A T

_ _ _ _ _ _ _ _ _ _ _

10. Errors in the pairing of the bases can be called a ______________ in the DNA and can cause genetic disorders.

Appendix B

Understanding the Structure of DNA – Post-Test

Name: ______________ **Date:** ____________ **Period:** ____________

1. A ______________ is the basic unit or building block of the DNA double strand.

2. ______________, ______________ and ______________ are the three parts of a nucleotide.

3. ______________ and ______________ are two types of bases in the DNA molecule.

Match the following definitions with the correct term.

4. ________ A base that pairs only with thymine

5. ________ A base that pairs only with guanine

6. ________ A base that pairs only with cytosine

7. ________ A base that pairs only with adenine

a. quanine

b. thymine

c. adenine

d. cytosine

8. The scientists that explained the double helix shape of DNA and received a Nobel Prize in 1962 were named ______________ and ______________.

9. Under the following list of bases, write the correct base sequence to pair with it.

T A T C G G T C A A T

_ _ _ _ _ _ _ _ _ _ _

10. Errors in the pairing of the bases can be called a ______________ in the DNA and can cause genetic disorders.

Appendix C - Figures

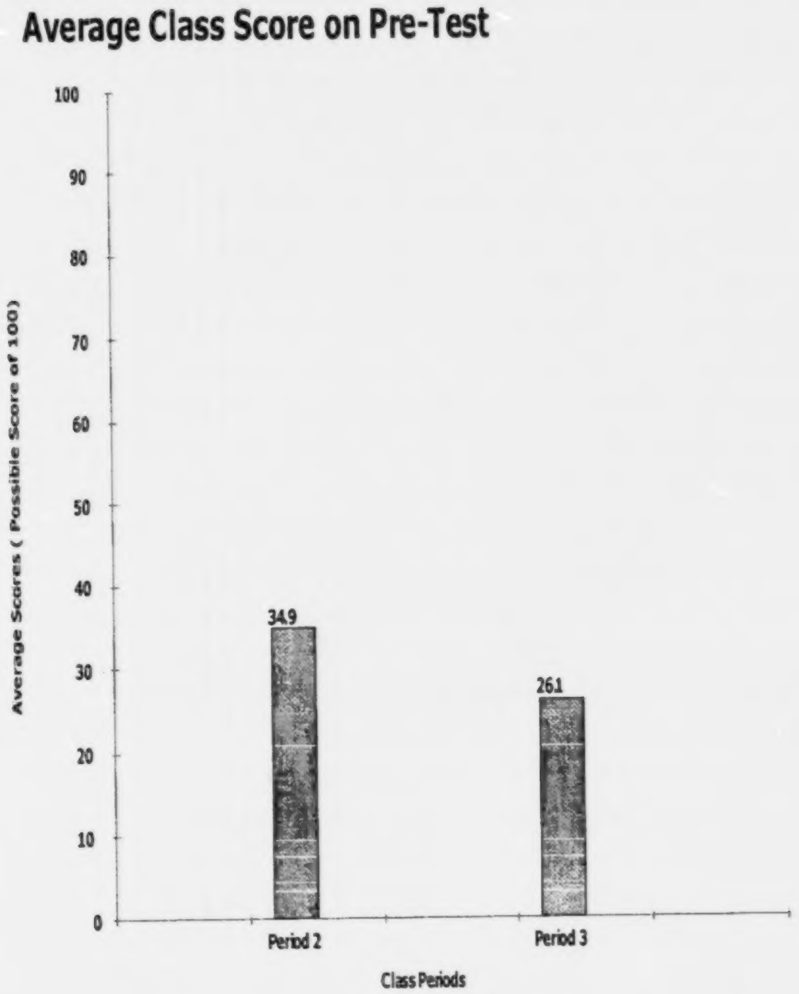

Figure 1. Average class score on pre-test.

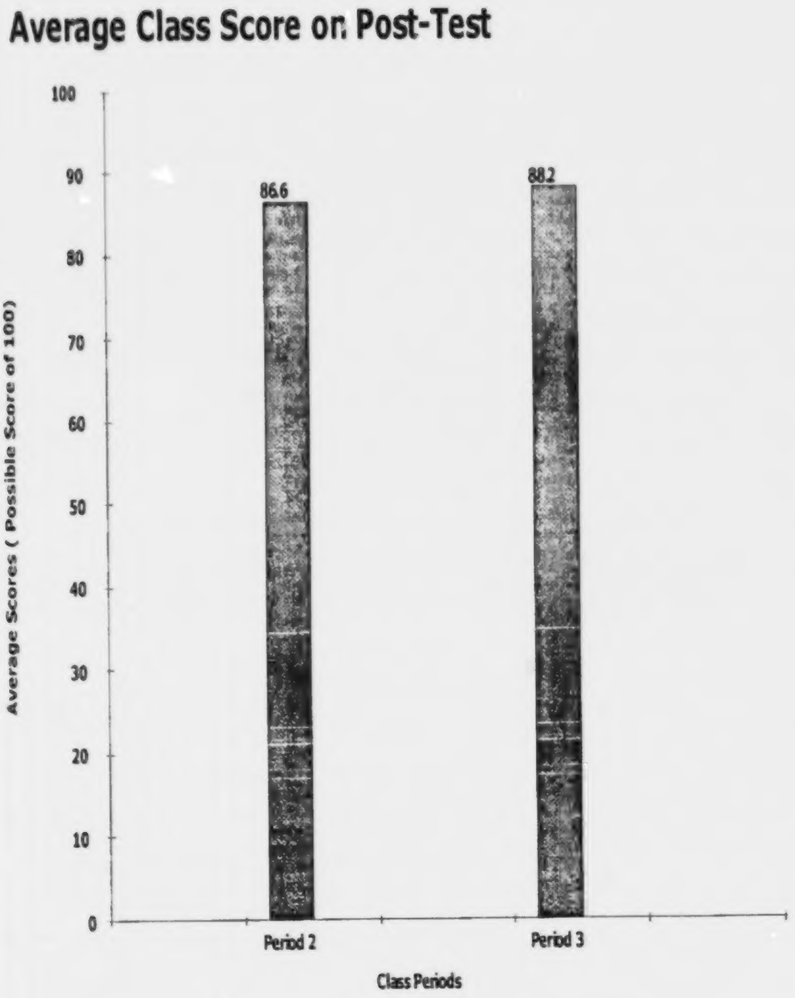

Figure 2. Average class score on post-test.

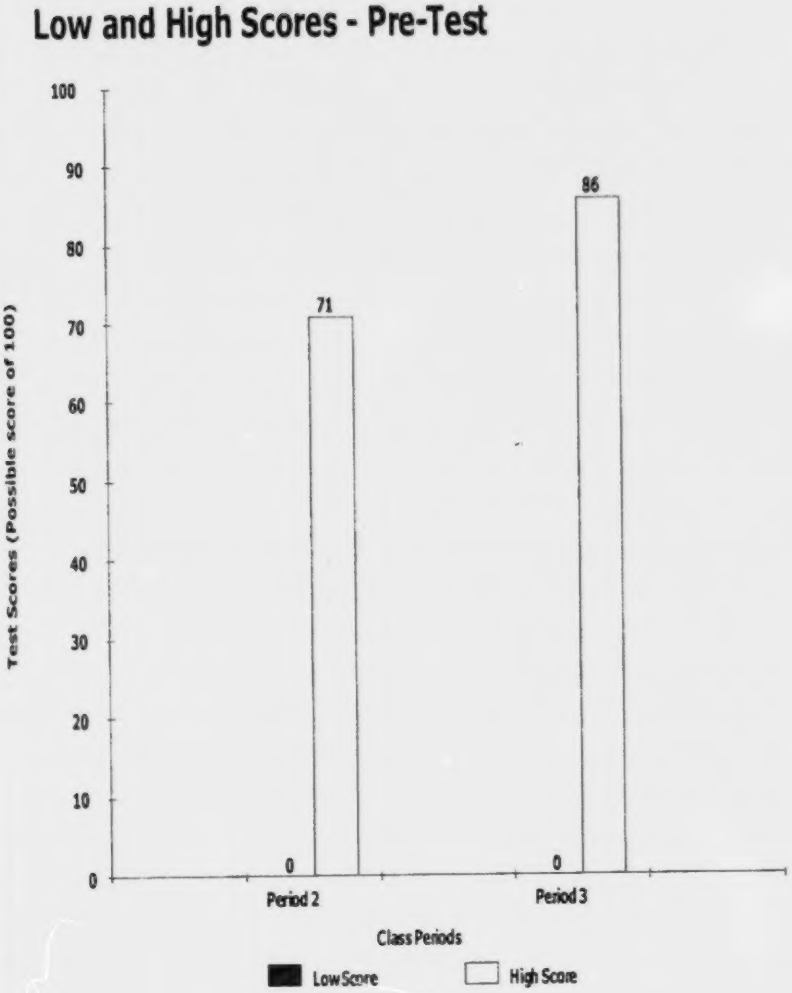

Figure 3. Low and high scores on pre-test.

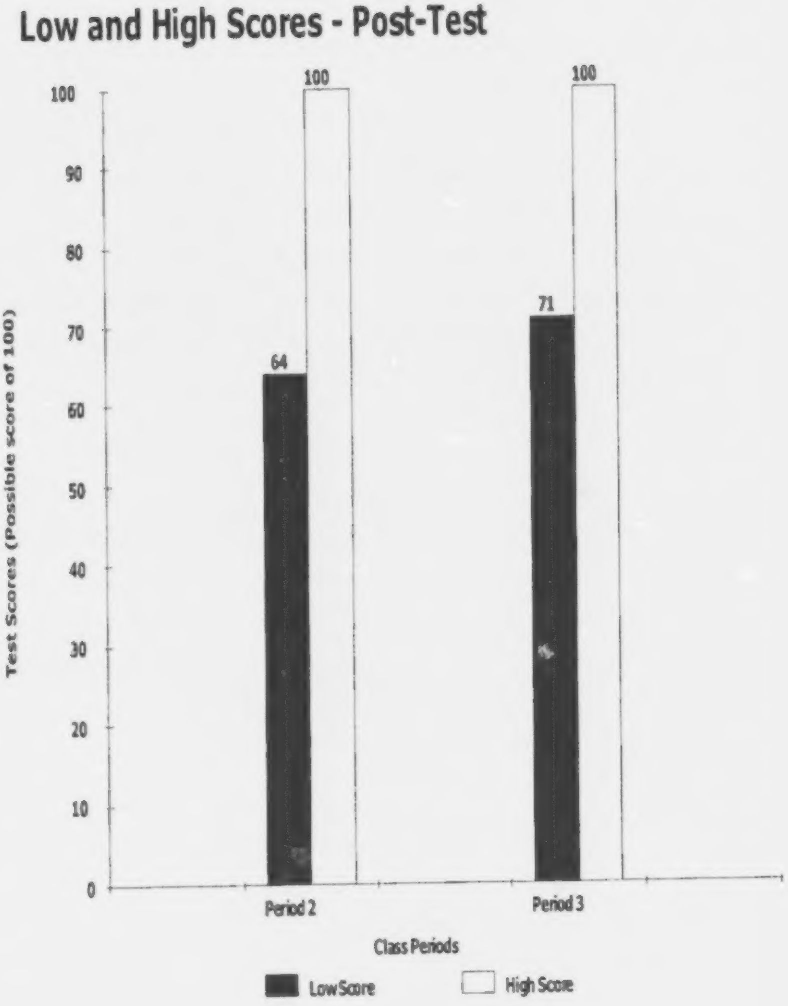

Figure 4. Low and high scores on post-test.

THE EFFECTIVENESS OF DIRECT INSTRUCTION WITH HIGH PRIORITY (LOW PERFORMING) MIDDLE SCHOOL STUDENTS

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The Effectiveness of Direct Instruction with At-Risk Students

Introduction and Review of the Literature

In recent years, there has been a considerable amount of attention directed to improving the academic achievement of at-risk students. Declining test scores in low-achieving students from disadvantaged backgrounds has brought this problem to the forefront. Addressing this problem has not only become an important educational issue, but also a significant social issue. The living conditions these children face are disturbing. More than 20% of the United States' youth live at or below the poverty level. The lack of effective education with this population creates a cyclical effect of poverty. The number of youth living in poverty is predicted to double by the year 2026 (Waxmon & Padron, 1994).

Educators have studied the plight of at-risk students in hopes of finding a solution or developing a counterattack to combat declining test scores. Although there are external variables that at-risk students face, such as lack of parental support, broken families, and high drug availability, most educational research examines the classroom strategies that can be used to help this struggling population. One area that has been studied intensely is classroom instruction. Classroom instruction has been found to be a critical factor in improving the educational outcomes for disadvantaged students. (Silvernail, 1989). The most common instructional method in schools is the direct instructional method. (Waxman & Padron, 1994). The direct instructional method as defined by Schweinhart and Weikart (1988) is an approach that emphasizes lecture and drilling and is done in a formal setting where the teacher has control over all decisions. Many educators and administrators believe this type of instruction fails to meet the individual needs of failing students and does not focus enough on higher-order thinking skills (Waxman & Padron, 1994). This review of literature will focus on the question of whether teacher-directed instruction does improve the academic achievement of at-risk students. My hypothesis is that teacher-directed instruction does improve achievement of at-risk students.

Since this topic is so widely debated across all content areas and all grade levels, the research experiments that were found were each conducted in a slightly different manner, each varying in the ages of the subjects and or the area of academic achievement. In a study done by Alfano (1985), achievement was studied under three modes of instruction: teacher-directed, computer-assisted, and student-centered. The subjects in the study were low-achieving, at-risk seventh graders who were being taught vocabulary lessons by way of these three different instructional methods. The results of the study showed that the students taught by the teacher-directed group faired significantly better than the other two groups. This study is powerful because it reveals that teacher-directed instruction is more effective than popular alternatives, such as student-centered approaches and computer-assisted methods. However, there are some limitations such as the study being based only on memorizing vocabulary words which requires only low-level thinking. Critics of teacher-directed instruction, as was mentioned earlier, would probably disregard this research because it does not focus on a higher-order thinking activity.

A more powerful study, performed by Lei and Rachor (2000), examined an urban public school which took part in a 3-year direct instruction program. The program was aimed to improve the academic performance of at-risk students. Unlike Alfano's (1985) study, Lei and Rachor's research examines how direct instruction affected the content areas of language arts and mathematics. The program was only implemented in grades 4 and 5. The control groups were taught by other instructional methods, however the specific methods were unmentioned. The findings revealed that direct instruction improved test scores in both areas at both grade levels. Although the findings found direct instruction effective, Lei and Rachor cautioned that direct instruction is not suitable for all occasions. In their conclusion, they mention that direct instruction can sometimes create passive students and make school a chore.

Although there were other studies (Brent & DiObilda, 1993) that revealed direct instruction to be effective in improving academic achievement of at-risk students, there were some studies that observed the opposite effects. Waxman and Padron found that at-risk students did not fair well in math or science when being taught by the direct instruction method. Their conclusion stated that direct instruction does not emphasize higher-order thinking skills and only focuses on basic skills or what they term "pedagogy of poverty." Ornstein (1995) reported similar findings in his research, although there was no mention of at-risk students not being taught higher-order thinking skills. He argued the reason direct instruction is not effective is because it is too passive and students are not allowed to interact with each other and engage in the learning process.

While the previously mentioned studies supported or undermined the effectiveness of direct instruction, most of the research found showed inconclusive evidence because of mixed findings. Ornstein (1995) reports that mixed findings may mean that other variables may have more of an impact on the achievement of at-risk students than instructional method. In an interesting study performed by Orth and Martin (1994), results showed that achievement was not affected by teaching style. However, the study did find that teaching style impacted behavior. Students who received teacher-directed instruction were more likely to exhibit off-task behaviors. The study performed by Schweinhart and Weikart (1988) also revealed mixed findings. This study was performed on low-achieving elementary students who were taught by a direct instruction method. This experimental group was compared to a control group that used what was termed a "laissez faire" method or a student-centered method. The groups did not significantly differ in their test scores.

As shown by the literature, studies have not been able to conclusively state that teacher-directed instruction is effective with at-risk students. The research methods used on this topic vary. Some of the studies tested achievement in at-risk elementary students, while others tested achievement in middle school and high school students. In this case, age might be a variable in whether direct instruction is effective. Another variable that had an effect on the effectiveness of direct instruction was the subject area being taught. From the studies, it seemed as if direct instruction was more effective for low-level thinking activities, such as memorizing definitions or learning multiplication tables. Direct instruction was less effective with at-risk students who were engaged in higher order thinking tasks, as found in science or advanced mathematics. The inconclusive findings may also have been affected by the experience and skill of the teachers used in each experiment.

Whether or not the direct instruction method is effective with at-risk students is a difficult question to answer. In the next few pages, I will reveal and describe the results of an experiment I conducted which was performed to determine the effectiveness of direct instruction with at-risk students, in this case middle school students.

Data Collection and Results

This experiment was performed in an eighth grade US History classroom in an urban Hamilton County middle school. The experiment was performed under the supervision of a coordinating teacher and a professor-in-residence.

The first step in the experiment was determining which students could be considered at-risk or high-priority. The cooperating teacher assisted in classifying students as high-priority based on previous academic achievement earned on progress reports. Once the classification process was completed, the at-risk students were randomly assigned to either the direct-instruction group or the student-centered instruction group. After students were placed in groups, they were instructed on the same material (expansion westward in the United States) for identical lengths of time (eight 60-minute class periods). The direct-instruction group was taught by lecturing and recurring drilling. The student-centered instruction group was taught by hands-on strategies such as the use of maps, artifacts, computer presentations, and small group learning. Both groups were given a pre-test and a post-test which were identical.

The results (Table 1 & Table 2) of the post-tests revealed that the students in the direct-instruction group achieved a greater average increase in test scores. Figure 1 and Figure 2 show that both groups improved their scores significantly. However, there is uncertainty in whether the difference in the improvement between the two groups is statistically significant.

Table 1

Direct-Instruction Results

	Direct Instruction Results	
Student	Pre-Test	Post-Test
1	12	60
2	40	56
3	16	80
4	32	80
5	44	64
6	44	76
7	44	80
8	36	72
9	36	84
10	32	52
11	40	80
12	40	60
13	40	68
14	28	92
15	28	68
16	32	64
17	40	64
18	28	72
Mean Score	34	70.7
Total % Increase		36.7
Mode	40	80
Median	36	70

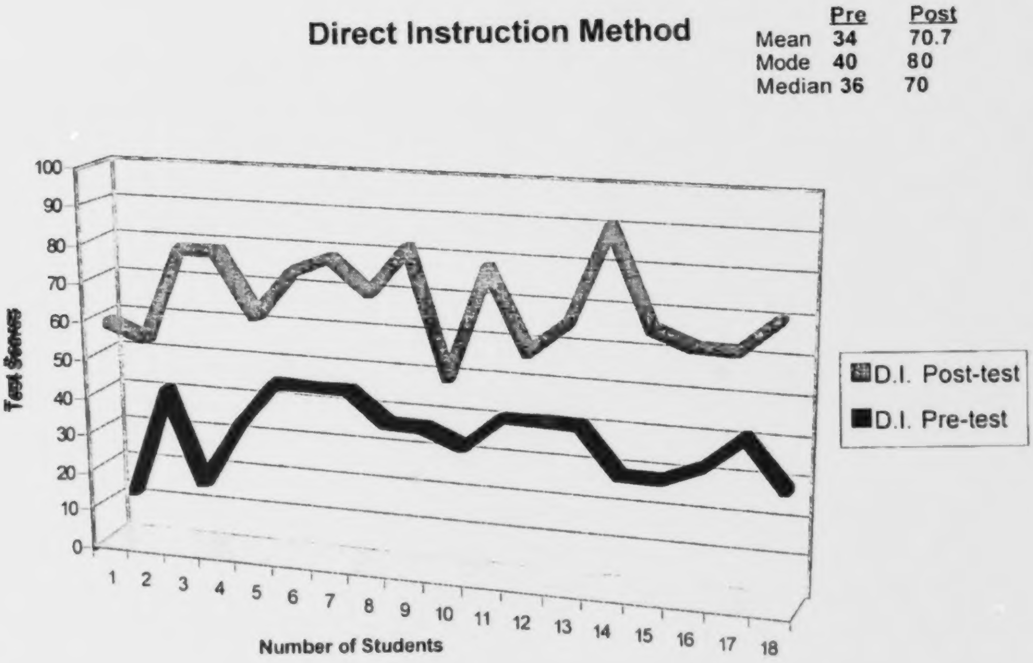

Figure 1. Direct -instruction results.

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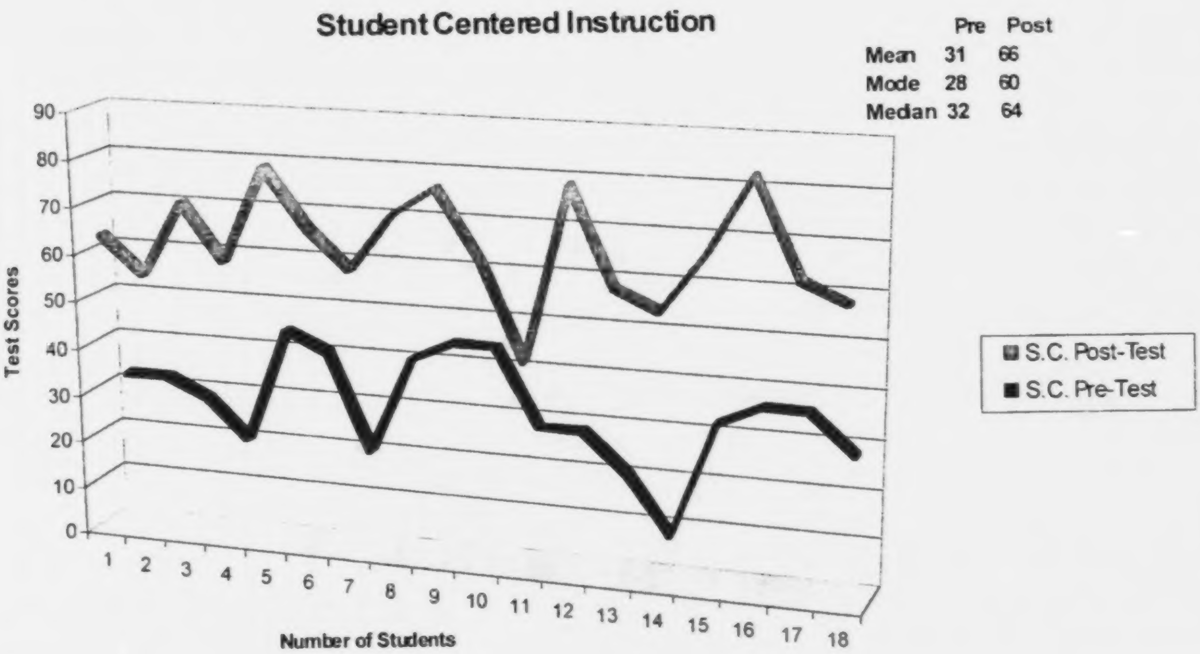
Table 2

Student-Centered Results

Student Centered Instruction Results

Student	Pre-Test	Post-Test
1	32	64
2	32	56
3	28	72
4	20	60
5	44	80
6	40	68
7	20	60
8	40	72
9	44	78
10	44	64
11	28	44
12	28	80
13	28	60
14	28	56
15	32	68
16	36	84
17	36	64
18	36	60
Mean Score	33.1	66.1
Total % Increase		33
Mode	28	60
Median	32	64



	Pre	Post
Mean	31	66
Mode	28	60
Median	32	64

Figure 2. Student-centered results.

Conclusions and Recommendations

As shown, the effectiveness of direct instruction with at-risk students is difficult to determine. The previous studies and experiments performed provide no clear evidence that low-achieving students perform better when being taught by the direct-instruction method. After evaluating the studies and the results from the experiment, I have come to my own conclusion that the quality of instruction is more important than the type of instruction. The National Middle School Association, which is the professional organization for middle school principals and teachers, does not promote any particular teaching strategy as being the remedy for improving the test scores of at-risk students. The NMSA calls for teachers to develop an arsenal of strategies appropriate for all different circumstances (Kilgore & Griffin, 1993). Based on the NMSA's recommendations and inconclusive findings from this study, I feel that more attention should be placed on the quality of teaching and determining the attributes of a quality teacher. Skills such as collaborating, organizing information, time management, and behavior management need to be a major focus during professional development workshops. From my brief experience of student teaching and through observing competent veteran teachers, these are the types of skills and attributes that will assist novice teachers in creating a conducive learning environment for at-risk students.

There is a considerable amount of grant money available for the purpose of educating at-risk students. Organizations such as the National Institute on the Education of At-Risk Students, The Tiger Woods Foundation, and the Milken Family Foundation are just a few of the philanthropic and research organizations working toward improving the academic achievement of at-risk students.

Technology can also play an important part in assisting low-achieving students. Web projects and online tutorials can be of assistance in allowing students to work at their own pace and take ownership in their work.

It is obvious that more studies are needed in this area. As mentioned earlier, researchers should focus more on the attributes of effective teachers rather than the different strategies those teachers are using. The quality of instruction has been shown to be much more crucial than the type of strategy used.

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COPY OF PRE-TEST/POST TEST

8th Grade US History

Pre-test/Post-test

Directions: If the question is multiple choice, write the letter of the correct answer. If the question is not multiple choice then write your answer. **Use your own paper.**

1.) Who were the two main candidates in the disputed election of 1824?

  a. James Madison and Andrew Jackson
  b. Andrew Jackson and John Q. Adams
  c. Henry Clay and James Madison
  d. Martin Van Buren and John Q. Adams

2.) Who helped John Q. Adams win the election of 1824?

3.) Andrew Jackson became famous after commanding forces at the Battle Of New Orleans during the ______________________.

  a. Revolutionary War
  b. French and Indian War
  c. War of 1812
  d. Spanish American War

4.) Andrew Jackson's nickname for being tough, hard and stubborn was ____________.

  a. Stick in the Mud
  b. Old Hickory
  c. Action Jackson
  d. Big Jack

5.) Jackson's victory in the 1828 election allowed him to fill cabinet and government positions with people who supported him. This system became known as ___________ ________________.

  a. Reward System
  b. Jackson's System

c. Victory System
d. Spoil System

6.) Which region of the country imported the most goods during the early 1800's?

7.) During Jackson's Presidency, Congress passed the highest tariff in the nation's history. This angered many people in the south. What was this tariff called?

a. Tariff of Jackson
b. Tariff of 1816
c. Tariff of Abominations
d. Tariff of Protection

8.) What region of the US did this tariff (tariff mentioned in question 7) benefit?

9.) The idea that a state can declare a federal law illegal is known as

a. Abomination
b. Nullification
c. Reconstruction
d. Prohibition

10.) Many southerners believed in ___________________, which means the right of a state to limit the power of the federal government.

a. State's Rights
b. Federalism
c. Reconstruction
d. Prohibition

11.) The ___________________ Indians adopted customs of white settlers, formed their own constitution, and created their own alphabet.

a. Choctaw
b. Cherokee
c. Chickasaw
d. Creek

12.) The trail of tears went through all of the following states **EXCEPT ...**

a. Arkansas
b. Tennessee
c. Virginia
d. Kentucky

13.) In 1830, Jackson and Congress forced Native Americans to sign treaties promising to move west of the Mississippi. This act was called the ____________________.

a. Tippecanoe Act
b. Nullification Act
c. Seminole Act
d. Indian Removal Act

14.) How did the Cherokees try to defend their land

a. They went to court to defend their land
b. They promised to scalp anyone who tried to force them out.
c. They protested Washington D.C.
d. They did not try to defend their land

15.) The sorrowful journey the Cherokees took west was known as the _________ ___ _________.

16.) Oregon Country consisted of lands ____________________________.

a. East of the Rockies
b. West of The Rockies
c. Between the Rocky and Appalachian Mountains
d. East of the Appalachian Mountains

17.) Write one of the two main reasons people settled in Oregon Country.

18.) Which of the following countries **did not** claim the land known as Oregon Country?

a. Spain

b. United States
c. Japan
d. Britain

19.) Which two countries made an agreement to claim the Oregon Country together?

a. Britain and Spain
b. Spain and Japan
c. Russia and United States
d. United States and Britain

20.) Approximately how long was the Oregon Trail.

a. 200 miles
b. 500 miles
c. 2000 miles
d. 5000 miles

21.) What was the biggest threat for the pioneers that traveled on the Oregon Trail.

a. Indian Attacks
b. Rain Storms
c. Blizzards
d. Sickness

22.) Which group of people did the pioneers trade with while on the trail?

a. Mountain Men
b. Mormons
c. Indians or Native Americans
d. Mexicans

23.) The belief that it was the United States duty and right to expand west was known as

a. Spoils System
b. Reward System
c. Manifest Destiny

d. American Dream

24.) Oregon Country consisted of lands ____________________________.

a. East of the Rockies
b. West of The Rockies
c. Between the Rocky and Appalachian Mountains
d. East of the Appalachian Mountains

25.) All of the following are reasons people moved west except:

a. Fur
b. Religious Freedom
c. Gold
d. Oil

PYTHAGOREAN THEOREM LEARNING ASSESSMENT IN URBAN HIGH SCHOOL GEOMETRY

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CASE STUDY

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Pythagorean Theorem Learning Assessment in Urban High School Geometry

Introduction

For the topic/title selected, "Pythagorean Theorem Learning Assessment in Urban High School Geometry," it originally appeared that synchronization would most likely occur between lesson plan schedules for this topic at the school where my student teaching took place, my University's Internal Review Board project approval which would allow for project start, desired witnessing of tutoring software practice, and completion of this case study. Another major factor for determining this topic was the choice we had for administering a pre-test/post-test on one of the topics we would teach, and determining the assumed learning that took place. The Pythagorean theorem is specifically mentioned by name in national and state standards as a required topic of study for students and already occupies my experienced curriculum in high school geometry and middle school algebra, more specifically NCTM Geometry Standard for Grades 6-8 and Tennessee Mathematics Framework Section 9 on spatial sense and geometric concepts, respectively (National Council of Teachers of Mathematics, 2000; Bellman, Bragg, Chapin, Gardella, Hall, Handlin, & Manfre, 1999). Lessons on the Pythagorean theorem hold a steady place today in the standards driving mathematics' classroom instruction in this country.

The original intent of my research was to see if data existed to show how the Pythagorean theorem might best be taught, especially to a group of students similar to those that I taught in my first student teaching assignment (urban/inner city high school sophomores through juniors). Fewer than ten findings using "Pythagorean theorem" and "research" were located in the ERIC search database, which could be related. ERIC No.

ED370763, entitled "*Mathematical Connections: Two Cases from an Evaluation of Students' Mathematical Problem Solving*" by T. L. Schroeder (1993a) used 17 10th-grade students to relate, with wide variety, worthiness of Pythagorean theorem and real world problems which became more a "connections" relationship than a 'how-to-teach-better' one. Also authored by Schroeder (1993b), "*Using the Pythagorean Theorem in a Contextualized Problem*," ERIC No. ED370764, indicated that students had difficulty interpreting an orally presented problem with photographs into a mathematical representation for solution, and those first attempting trigonometric solutions made the solution more problematic than they would have using the Pythagorean theorem.

The students in my classes were using the *Cognitive Tutor Geometry* software and supporting materials, including textbooks, so I decided to change my case study background research into finding any value-ad for this teaching tool I had no option of using. Evidential material was also hard to come by. I received support from John Kosakowski, an AskERIC Digital Reference Specialist, who found just a few more sources than I did. The findings were of short order on independent critiques but a large amount of support for the program came from its developer/publisher/supplier. Numerous and monopolizing accolades, in my opinion at this time, are mentioned next in summary, minus any statistical content support. One must keep in mind that due to limited supply of the product to date, only 100 schools, much more analytical data is yet to be collected once the product is further distributed to get a truer picture of its value. This is being done unbiased by Carnegie Learning and published on their website (PACT Center, 2003).

Review of Literature

Kenneth R. Koedinger is an Associate Professor at Carnegie Mellon University and Coordinator of the Pittsburgh Advanced Cognitive Tutor Center who holds a BS degree in Mathematics and advanced degrees in Computer Science and Cognitive Psychology. Teams create 'Cognitive Tutors' from his computer simulations of student thinking and learning models. The Cognitive Tutors immerse students in problem solving environments that are "just-in-time-assistance," much like a human tutor would do. Students in experimental development programs have improved two-fold over targeted real world problem solving skills and up to 25 percent better on standardized tests (Koedinger, 2003).

Carnegie Learning, Inc., who markets *Cognitive Tutor,* advertises the Tutors in the following way, specifically geometry. Topics do include the Pythagorean theorem, which guides intended instruction to be done in my student teaching. Overall, geometry is intended to promote geometric concepts and spatial reasoning skills. Group activities, manipulatives, and software allow concrete to abstract thinking. It's learning-by-doing pedagogy where pace is an individual's. Connections are also made to algebra (such as the tutored help of solving one- and two-step equations). "Self confidence in doing math increases," according to one Houston, Texas, associate principal. "No one rushes through the work and all engage in the learning process." Aside: my experience showed otherwise on both these points.

Problems are presented in real-world terms. The problems are encountered through the representations of worksheet, diagrams, equations, and written tests. Multi-representational components include SCENERIO, or problem description; the

WORKSHEET, where answers are entered (incorrect responses are not accepted) and students receive help responses if they decide to use them; DIAGRAM is a "picture" of the problem; SKILLS bars advance to show students' progress turning green to gold indicating mastery; and GLOSSARY displays help via definitions, examples, and illustrations.

It is intended that the software use make up 40% of the week's class time. Understanding human thinking was the working premise that devised the whole Tutor program. The advertisement says that there are proven results that the students are motivated, challenged, engaged, and successful. Teachers bring students from using informal problem solving methods to solve simple problems with more formal methods and sophistication. Exercises in the textbook also encourage students' thinking, especially when multiple problem solving strategies are required. There is a high quantity of representation in the form of text, equations, graphs, and tables. Writing is integral. Linking causes students to reflect on prior knowledge. The software itself guides students via model tracing (responses to students' own actions) and knowledge tracing by assigning successive problems judged on prior strengths and weaknesses shown. Immediate and dynamic feedback to the student is possible in much the same way as they would get it from a human tutor. Connections are made with real world problems. When students make mistakes, they cannot proceed without getting the program's assistance, or, as witnessed in my case, continued guessing until problem is solved. Continual assistance is truly available. The program is truly self-paced. Skills are constantly monitored through movement of on-screen skill bars, and non-mastered skills cause new problems in that area of weakness (Carnegie Learning, 2002a).

Cognitive Tutor has also addressed their accomplishments with the No Child Left Behind legislation.

First,

Title I: Comprehensive School Reform policies

- Employ proven strategies and methods for student learning, teaching, and school management based on repetitive scientific research and practices;
- Close the achievement gap between diversities;
- Cause effective school functioning bringing together curriculum, technology, and professional development enabling students to meet required academic achievements;
- Provide administration and teacher support;
- Improve students involved.

Second,

Title II: Enhancing Education through Technology is obviously impacted (Carnegie Learning, 2002b).

As told earlier, only limited research on *Cognitive Tutor* performance, which is not linked to Carnegie Learning's web page, exists. However, two findings report once again impressive results relating exemplary results with Tutor's tie to real world situations and a recent Teacher Corp program set up for new potential users (Linn, Kessel, & Slotta, 2003). Additionally, Wise County (VA) schools has had their software review committee examine the *Cognitive Tutor Geometry* and found it to be 'exceptional' in all applicable review areas. They noted that fullest potential cannot be realized until teachers receive Carnegie Learning training, which is included with the price of the package (Johnson, 2003).

Data Collection and Results

To measure knowledge gained by the students that I student taught on the Pythagorean theorem, a test instrument (contained in Appendix A) was prepared from goals and objectives gleaned from *Cognitive Tutor Geometry* text on the subject. The test, composed of eight variably-weighted questions, three with multiple parts, including matching, addressed right triangle definition, identification, Pythagorean theorem identification through patterns, determining missing side lengths on right triangles, right triangle component nomenclature, isosceles right triangle definition, and side length relationships held in special right triangles. The test was administered to students before classroom instruction started on the unit and re-administered at the conclusion of the unit's presentation. Since the classes met in 80-minute block schedules, approximately 20 minutes was given for test completion.

The students would, and I was informed nominally, always lag behind in software practice as compared to classroom and textbook activities, which meant I would most likely never witness the result of computer program interface on this subject before needing to conclude my case study. There were still gains made as described below in the narrative, and graphically represented with charts and graphs. Only the tests taken on the original dates were analyzed in this case study. No make-ups were given. Comparisons were made accordingly. Fifty-eight pre-tests and 57 post-tests were given. The actual pre-test scores are presented in Table 1 and post-test scores are presented in Table 3.

It was also desirous to know performance improvement on each individual question or component of a question to identify where instruction was on track or needed further attention. A tally of correct, incorrect, and blank answers was made by hand then tabulated, based on percentage of that question. For instance, 10 test responses were made on question 1: 2 blanks, 3 incorrect, and 5 correct answers, of which the percentages would be 20%, 30%, and 50%, respectively. See Table 2 and Table 4, respectively, for tallies on pre-test and post-test questions. Comparisons could now be made between tests to see change in correct, incorrect, and blank responses in terms of percent improvement or decline.

The pre-test score range was 0-78 with a mean of 16.8, median of 12 and mode of 0. The post-test score range was 0-100 with a mean of 39.9, median of 44 and modes of 24, 18, and 0. Overall, the mean and median of test scores did increase between the tests, not at very impressive levels, but still considered an admired accomplishment by my cooperating teacher and myself.

Conclusions and Recommendations

Two positives resulted when looking at the test questions individually. The bar graphs, presented in Appendices B and C, indicate that the percent correct for each question increased between the two tests. The test question on hypotenuse identification increased most with 41% improvement. The least improved correctness tied between the 60-degree angle identification and two side lengths' characteristic on a 45-45-90 special right triangle. Correctness on six other questions improved more than 25 percent. The number of questions left blank decreased for every question between the tests (20% or better for five of them). This could be interpreted that students understood the question better the second time around.

Unappealing was the fact that the percentage of incorrect answers decreased on half of the test questions but increased the other half. Overall decrease in percentage of incorrect answers outweighed the increase in percentage of incorrect by 26 percent. The best decrease indicated the students were beginning to understand very well what a right triangle is.

The instruction presented between tests most definitely made mention and practice out of the test material. The material on these tests, however, was made no more important than any of the other information taught in the unit.

Issues to emphasize during instruction certainly could be gathered from material least known on the pre-test. Prefaces to the students indicating they did not do well on this or that item because of the pre-test could be artillery the teacher needs to have to direct longer and further instruction on missed points.

The test results were quite typical to the past and present performances of the students taught throughout this placement. Computer tutoring software they used during this course focused more on real world applications than covering literal basics.

Teaching Pythagorean theorem, according to NCTM, is also an avenue of visual study and geometric modeling. For instance, square extensions from each leg of a right triangle add together to obtain the same area of the square extension off the hypotenuse. This exploration magnifies skills in other geometry concepts and patterns. The interactive example used above was shown to students in these classes I taught.

A recommendation I personally would want for teacher professional development would be training on balancing technology (computer lab work in the math classroom) and other teaching strategies to benefit students the most. Additionally, Carnegie Learning has developed an excellent research tool by supporting and guiding continued evaluative processes for their product. It needs to be kept up. Note: the feedback portion of their research web page has only recently been available. *Cognitive Tutor* is technology extreme.

Table 1

Frequency of Scores on Pre-Test

TEST SCORE	Frequency of Score
78	1
72	1
60	1
46	1
40	1
38	1
36	1
34	1
32	1
28	2
26	1
24	2
22	4
20	2
18	2
16	2
14	1
12	2
10	6
8	6
6	4
4	6
0	7

Table 2

Pre-Test Answer Distribution

Problem Number	# CORRECT %	# INCORRECT %	# LEFT BLANK %
1	26	43	31
2a	55	17	28
2b	22	40	38
3	2	36	62
4	41	26	33
5a	3	42	55
5b	3	42	55
6a	15	42	43
6b	24	34	42
6c	24	40	36
6d	22	28	50
6e	43	10	47
7	9	26	65
8	19	10	71

Table 3

Frequency of Scores on Post-Test

TEST SCORE	Frequency of Score
100	2
84	1
82	1
80	1
76	1
72	2
70	1
62	2
60	1
58	2
56	1
54	2
52	3
50	1
48	2
44	3
42	1
36	1
34	2
32	1
30	1
28	2
26	3
24	4
22	1
20	2
18	4
14	1
12	1
8	3
0	4

Table 4

Post-Test Answer Distribution

Problem Number	# CORRECT %	# INCORRECT %	# LEFT BLANK %
1	60	23	17
2a	68	17	15
2b	47	33	20
3	39	26	35
4	67	12	21
5a	33	32	35
5b	16	42	42
6a	26	53	21
6b	26	51	23
6c	35	44	21
6d	63	19	18
6e	74	12	14
7	19	28	53
8	21	18	61

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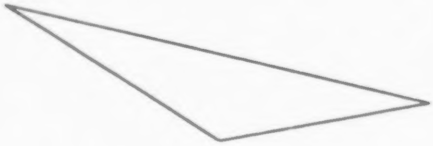
Appendix A
Test Instrument

1. What is a right triangle? 4 pts.

   Answer: A triangle with a 90-degree angle.

2. Does this figure represent a right triangle? 2 pts.



   Answer: No.

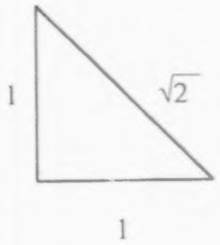
   Why? 3 pts.

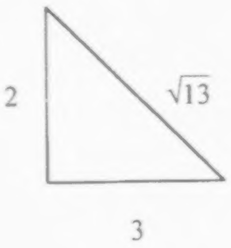
   Answer: It does not include a 90-degree angle.

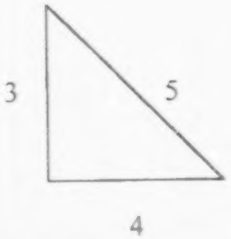
3. Given the following triangles, there is an algebraic expression used for each triangle, which describes a pattern for the length of each side.

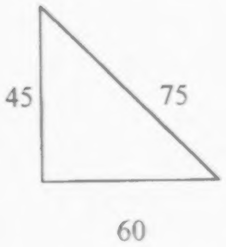
What pattern is developing? Write it in terms of variables a, b, and c. 10 pts.

Hint: It involves squares and square roots.
Note: Triangles are not drawn to scale. **Answer: $a^2 + b^2 = c^2$**



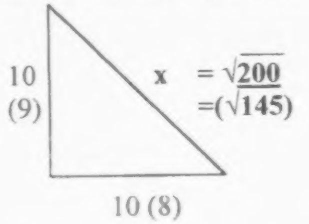


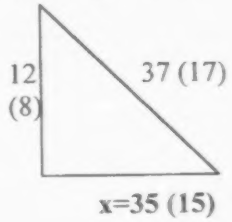




4. The **Pythagorean** Theorem explains the relationship you see developing between the triangles in Exercise 3. 3 pts.

5. Determine the missing side length (x) of each triangle. 5 pts. each

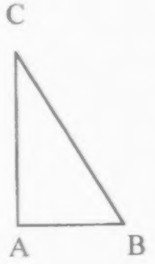

10
(9)
x
= √200
=(√145)
10 (8)

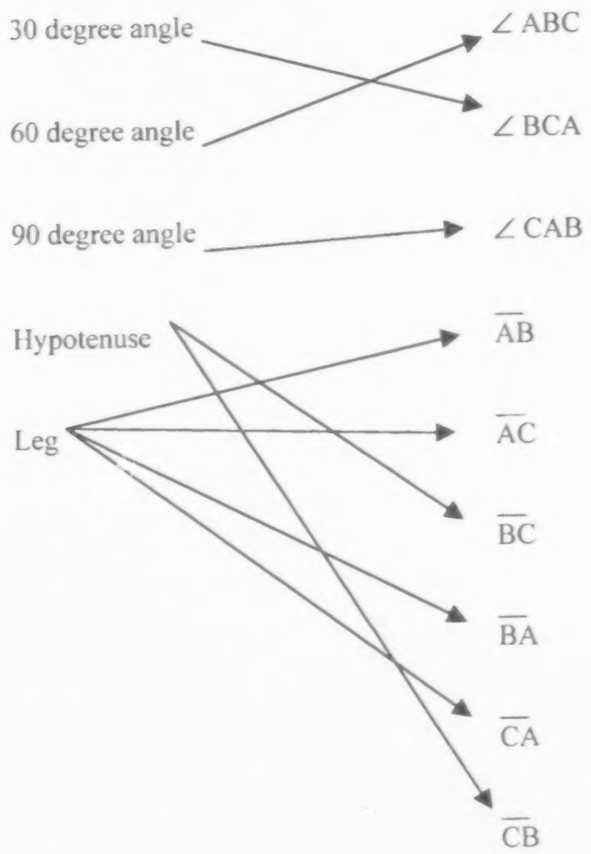

12
(8)
37 (17)
x=35 (15)

6. A 30-60-90 triangle has one 30-degree angle, one 60-degree angle, and one 90-degree angle. The following 30-60-90 triangle is drawn close to scale.

Match the term in the left-hand column with the appropriate term in the right-hand column using a line.

2 pts. each

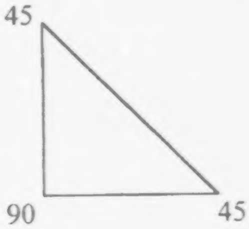



30 degree angle
60 degree angle
90 degree angle
Hypotenuse
Leg
∠ ABC
∠ BCA
∠ CAB
$\overline{AB}$
$\overline{AC}$
$\overline{BC}$
$\overline{BA}$
$\overline{CA}$
$\overline{CB}$

7. An **_isosceles_** right triangle is a right triangle with two sides of equal measure. 3 pts.

8. A 45-45-90 triangle has two 45-degree angles and one 90-degree angle. What can you conclude about the length of 2 sides on that triangle? 5 pts.

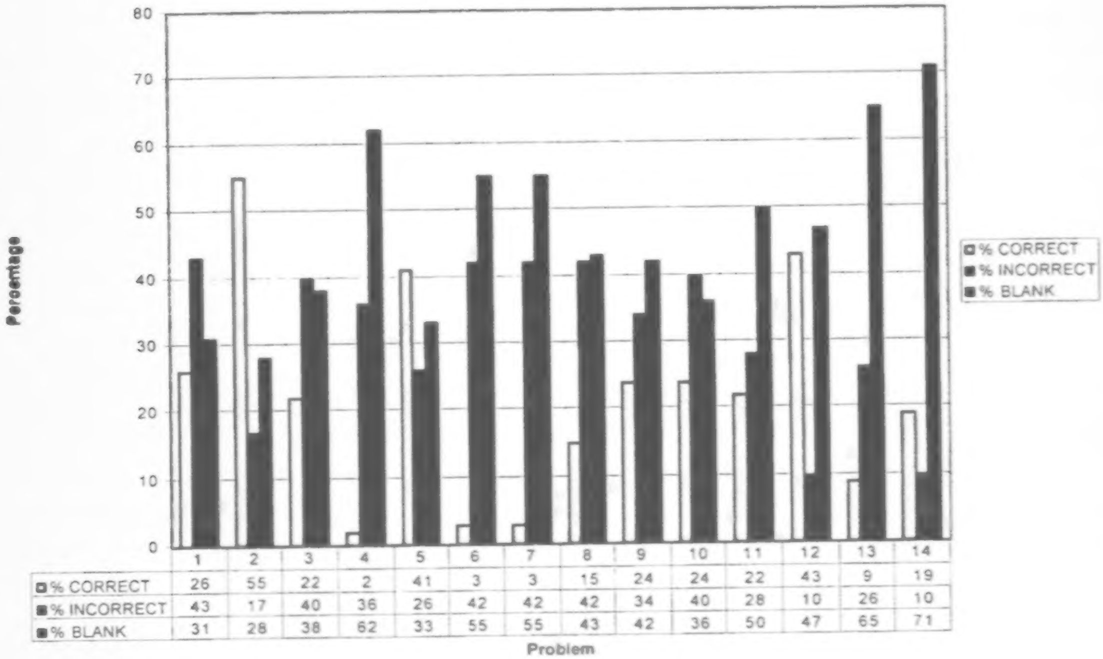
Answer: The two sides opposite the 45-degree angles have the same length.



Appendix B

Pre-test results

Appendix B
PRETEST RESULTS



	1	2	3	4	5	6	7	8	9	10	11	12	13	14
☐ % CORRECT	26	55	22	2	41	3	3	15	24	24	22	43	9	19
■ % INCORRECT	43	17	40	36	26	42	42	42	34	40	28	10	26	10
■ % BLANK	31	28	38	62	33	55	55	43	42	36	50	47	65	71

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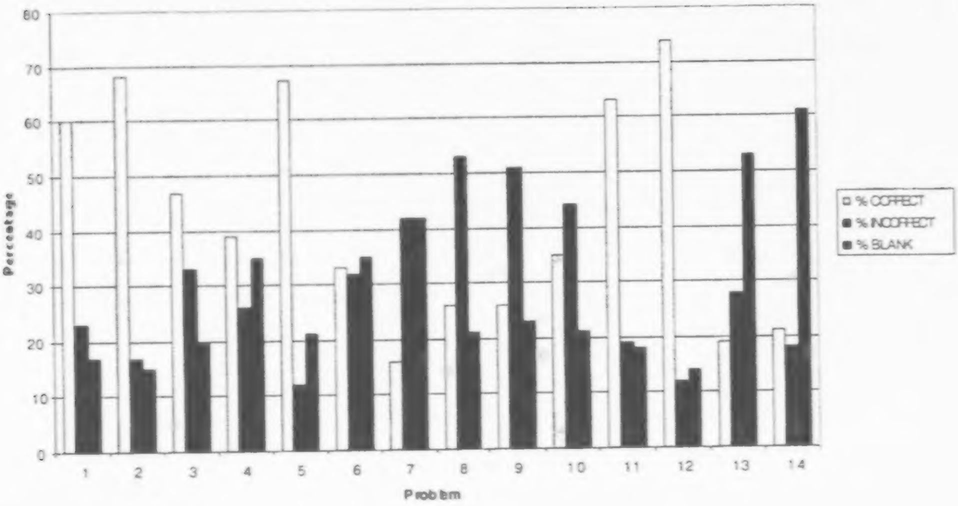
Appendix C
POST-TEST RESULTS



FLEXIBILITY WITH THE SIT AND REACH TEST

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Introduction

I am interested in the effect stretching actually has over one's flexibility or range of motion. Flexibility is defined as "the absolute range of movement in a joint or series of joints that is attainable in a momentary effort with the help of a partner or a piece of equipment" (Altos Air Force Base Physical Fitness Center, n. d.). This definition tells the reader that flexibility is not something general, but rather flexibility is specific to a particular joint or set of joints. In other words, it is a myth that some people are innately flexible throughout their entire body. Being flexible in one particular area or joint does not necessarily imply being flexible in another. Being "loose" in the upper body does not mean you will have a "loose" lower body. Many people are unaware of the fact that there are different types of flexibility. These different types of flexibility are grouped according to the various types of activities involved in athletic training. The types of flexibility which involve motion are called dynamic, and the types of flexibility which do not involve motion are called static. The different types of flexibility (according to Kurz, 2000, ¶ 2) are:

dynamic flexibility

> Dynamic flexibility is the ability to perform dynamic movements of the muscles to bring a limb through its full range of motion in the joints.

static-active flexibility

> Static-active flexibility is the ability to assume and maintain extended positions using only the tension of the agonists and synergists while the antagonists are being stretched.

static-passive flexibility

> Static-passive flexibility is the ability to assume extended positions and then maintain them using only your weight, the support of your limbs, or some other apparatus. The ability to maintain the position does not come solely from your muscles, as it does with static-active flexibility.

Research has shown that active flexibility is more closely related to the level of sports achievement than is passive flexibility. Active flexibility is harder to develop than passive flexibility, however, overall active flexibility requires passive flexibility in order to assume an initial extended position; it also requires muscle strength to be able to hold and maintain that position.

Literature Review

Recommendations to stretch or not to stretch are full of misconceptions and conflicting research. There is limited evidence to sort out these issues. Stretching has been promoted for years as an essential part of a fitness program as a way to decrease the risk of injury, prevent soreness, and improve performance. But what does the evidence support?

The current research suggests that stretching can decrease pain and soreness after exercise. However, no evidence supports the theory that stretching immediately before exercise can prevent overuse or acute injuries. Much of this confusion comes from a misinterpretation of research on warm-up. Most of the studies found that warming-up by itself has no effect on range of motion, but that when stretching follows the warm-up, there is an increase in range of motion. Many people misinterpreted this finding to mean that stretching before exercise prevents injuries, even though the clinical research suggests otherwise. A better interpretation is that warm-up prevents injury, whereas stretching has no effect on injury. If injury prevention is the primary objective, the evidence suggests that athletes should limit the stretching before exercise and increase warm-up (Kurz, 2000, ¶ 1).

When looking at the effect of stretching alone on range of motion, a review of MEDLINE (Community of Science, Inc., 2003) finds that for both the immediate (1 hour) and long-term (several weeks) improvements in range of motion one 15 to 30 second stretch per muscle group is sufficient for most people. Some people require longer duration or more repetitions. Research also supports the idea that the optimal duration and frequency for stretching may vary by muscle group.

The long-term effects of stretching on range of motion show that after 6 weeks, those who stretch for 30 seconds per muscle each day increased their range of motion much more than those who stretched 15 seconds per muscle each day. No additional increase was seen in the group that stretched for 60 seconds (Kurz, 2000, ¶4). Another 6-week study conducted found that one hamstring stretch of 30 seconds each day produced the same results as three stretches of 30 seconds. These studies support the use of 30-second stretches as part of general conditioning to improve range of motion.

To get the most from your stretching, you need to customize your routine to fit your needs. One way to do this is to stretch, until you feel slight pulling but no pain. As you hold the stretch the muscle will relax. As you feel less tension, you can increase the stretch again until you feel the same slight pull. Hold this position until you feel no further increase. If you do not seem to gain any range of motion using the above technique, you may consider holding the stretch longer (up to 60 seconds) (ActiveLifeNetwork, 2002, ¶ 2-6).

In general, Proprioceptive Neuromuscular Facilitation (PNF) stretching has resulted in greater increases in range of motion compared with static or ballistic stretching, though some results have not been statistically significant (Webb, 2002, ¶ 1). Static stretches are a bit easier to do and appear to have good results. Studies indicate that continuous stretching without rest may be better than cyclic stretching (applying a stretch, relaxing, and reapplying the stretch), however, some research shows no difference. Most experts believe ballistic, or bouncing during a stretch, is dangerous because the muscle may reflexively contract if restretched quickly following a short relaxation period. Such eccentric contractions are believed to increase the risk of injury.

In addition to improving range of motion, stretching is extremely relaxing and most athletes use stretching exercises to maintain a balance in body mechanics. Perhaps, one of the biggest benefits of stretching, may be something the research cannot quantify: it just feels good.

Data Collection and Results

Flexibility is the capacity of a joint to move through its full range of motion. There is no single test that gives you a score for overall flexibility. Each test is specific to a particular movement or joint. There are indirect and direct methods of measuring flexibility. The indirect method usually involves the linear measurement of distances between segments or from an external object, while direct methods measure angular displacements between adjacent segments or from an external reference (Kurz, 2000, ¶ 4).

The sit and reach test involves sitting on the floor with legs out straight ahead. Feet (shoes off) are placed flat against the box. The tester holds both knees flat against the floor. The person leans forward slowly as far as possible and holds the greatest stretch possible for 2 seconds. The tester makes sure that there are no jerky movements, the fingertips remain level, and the legs flat.

The score is recorded as the distance before (negative) or beyond (positive) the toes. Repeat three times and record the best score. Table 1 (below) gives one a guide for expected scores (in cm) for adults.

Table 1.
Category Values for Sit and Reach Test

Category	Men	Women
Super	>+27	>+30
Excellent	+17 to +27	+21 to +30
Good	+6 to +16	+11 to +20
Average	0 to +5	+1 to +10
Fair	-8 to -1	-7 to 0
Poor	-19 to -9	-14 to -8
Very Poor	<-20	<-15

The equipment required for the sit and reach test is the sit and reach box (or a ruler can be used, held between the feet). This test only measures the flexibility of the lower back and hamstrings, and is a valid measure of this. The reliability will depend on the amount of warm-up allowed, and whether the same procedures are followed each time. Most norms are based on no previous warm-up. The only disadvantage to this test is the variations in arm, leg, and trunk length, which can make comparisons between individuals misleading.

The purpose of this study was to determine the effect of regular and repeated stretching on flexibility. Subjects were selected from two equal eighth grade physical education classes at an urban, secondary school in Hamilton County. One class performed the repeated stretches three times each week for 4 weeks, under the same conditions each week. The control group did not stretch between tests. Subjects performed several static stretches each day, the details of which will be outlined later. Pre- and post-test measurements were taken. The subjects were 40 male and female students, with no history of hamstring or lower back injury nor any participation in a stretching program within the past 6 months.

According to (*Kurz*, 2000, ¶ 8), flexibility is affected by the following factors:

- Internal influences
    - The type of joint
    - The internal resistance within a joint
    - Bony structures which limit movement
    - The elasticity of muscle tissue
    - The elasticity of tendons and ligaments
    - The elasticity of skin
    - The ability of a muscle to relax and contract to achieve the greatest range of movement
    - The temperature of the joint and associated tissues (joints and muscles offer better flexibility at body temperatures that are 1 to 2 degrees higher than normal)
- External influences
    - The temperature of the place where one is training (a warmer temperature is more conducive to increased flexibility)
    - The time of day
    - The stage in the recovery process of a joint or muscle after injury
    - Age

- Gender (females are generally more flexible than males)
- One's ability to perform a particular exercise
- One's commitment to achieving flexibility
- The restrictions of any clothing or equipment

Some of the more common factors which limit one's flexibility are bone structure, muscle mass, excess fatty tissue, and connective tissue. Depending on the type of joint involved and its present condition, the bone structure of a particular joint places very noticeable limits on flexibility. This is a common way in which age can be a factor limiting flexibility since older joints tend not to be as healthy as younger ones. In the test that was performed, the subjects were all eighth graders, and the sex of the subjects was split 50/50 between the two classes. The gymnasium was approximately 70 degrees at all times, and both classes were tested at 2:00 p.m. each day. All external influences were monitored, and hopefully, considered and controlled.

Just as there are different types of flexibility, there are also different types of stretching. Stretches are either dynamic (meaning they involve motion) or static (meaning they involve no motion). Dynamic stretches affect dynamic flexibility and static stretches affect static flexibility. The different types of stretches are:

1. ballistic stretching
2. dynamic stretching
3. active stretching
4. passive stretching
5. static stretching
6. isometric stretching

7. PNF stretching

Ballistic stretching uses the momentum of a moving body or a limb in an attempt to force it beyond its normal range of motion. This is stretching, or "warming up," by bouncing into a stretched position, using the stretched muscles as a spring, which pulls you out of the stretched position. This type of stretching is not considered useful and can lead to injury because it does not allow your muscles to adjust to, and relax in, the stretched position. Instead, it may cause them to tighten up by repeatedly activating the stretch reflex.

Dynamic stretching, according to Kurz, "involves moving parts of your body and gradually increasing reach, speed of movement, or both" (Kurz, 2000, ¶ 3). Do not confuse dynamic stretching with ballistic stretching! Dynamic stretching consists of controlled leg and arm swings that take you to the limits of your range of motion, whereas ballistic stretches involve trying to force a part of the body beyond its range of motion. In dynamic stretches there are no bounces or jerky movements.

According to Kurz, dynamic stretching exercises should be performed in sets of 8-12 repetitions, though it is important to stop when, and if, you feel tired (Kurz, 2000, ¶ 3). Tired muscles have less elasticity, which decreases the range of motion used in your movements. Continuing to exercise when you are tired serves only to reset the nervous control of your muscle length at the reduced range of motion used in the exercise. Once you attain a maximal range of motion for a joint in any direction, you should stop doing that movement during that workout. Tired and overworked muscles will not attain a full range of motion and the muscle's kinesthetic memory will remember the repeated shorted range of motion, which you will then have to overcome before you can make further progress.

An active stretch is one where you assume a position and then hold it with no assistance other than using the strength of your agonist muscles. Active stretching increases active flexibility and strengthens the agonistic muscles. Active stretches are usually quite difficult to hold and maintain for more than 10 seconds and rarely need to be held any longer than 15 seconds.

A passive stretch is one where you assume a position and hold it with some other part of your body, or with the assistance of a partner or some other apparatus. Slow, relaxed stretching is useful in relieving spasms in muscles that are healing after an injury. Relaxed stretching is also very good for cooling-down after a workout and helps reduce post-workout muscle fatigue, and soreness. Many people use the term "passive stretching" and "static stretching" interchangeably. However, there are a number of people who make a distinction between the two. According to Kurz, static stretching consists of stretching a muscle to its farthest point and then maintaining or holding that position, whereas passive stretching consists of a relaxed person who is relaxed while some external force brings the joint through its range of motion (Kurz, 2000, ¶ 6).

Isometric stretching is a type of static stretching which involves the resistance of muscle groups through isometric contractions of the stretched muscles. The use of isometric stretching is one of the fastest ways to develop increased static-passive flexibility, and is much more effective than either passive stretching or active stretching alone. Isometric stretches also help to develop strength in the tensed muscles, and seem to decrease the amount of pain usually associated with stretching. Isometric stretching is not recommended for children and adolescents whose bones are still growing. These people are usually already flexible enough that the strong stretches produced by the isometric contraction have a much higher risk of damaging tendons and connective tissue. Kurz strongly recommends preceding any isometric stretch of a muscle with dynamic strength training for the muscle to be stretched. A full session of isometric stretching makes many demands on the muscles being stretched and should not be performed more than once per day for a given group of muscles.

PNF stretching is currently the fastest and most effective way known to increase static-passive flexibility. It is not really a type of stretching, but rather, it is a technique of combining passive stretching and isometric stretching in order to achieve maximum static flexibility. PNF refers to any of several post-isometric relaxation stretching techniques in which a muscle group is passively stretched, then contracts isometrically against resistance while in the stretched position, and then is passively stretched again through the resulting increased range of motion. PNF stretching usually employs the use of a partner to provide resistance against the isometric contraction, and then later to passively take the joint through its increased range of motion. A muscle should be rested and relaxed for at least 20 seconds before performing another PNF technique.

The stretches used during this study were active stretches. Each student in the experimental group performed between 10 and 12 different stretches each class period. The stretches consisted of:

1. Back Press-up
2. Supine Hamstring Stretch
3. Seated Hamstring Stretch

4. Piriformis Stretch
5. Inner Thigh/Groin Stretch
6. Lumbar Rotation Stretch
7. Tensor Stretch
8. Toe Touch
9. Crossover Toe Touch
10. Leg Extension to Side Lunge
11. Hurdle Stretch
12. Stuck In Cement

At the beginning of March, each student was given a sit and reach pre-test to measure their flexibility. At the end of April, the exact test was administered again as a post-test to judge the results. The control group's results for the pre- and post-tests are presented in Table 2 and Table 3. (All names are concealed for privacy reasons.)

Table 2
Control Group Pre-Test Sit and Reach

Control Group	**3/17/2003**	**Pre-Test**	
	Reach One	**Reach Two**	**Reach Three**
Student 1	5	7	9
Student 2	9	10	11
Student 3	4	3	4
Student 4	10	11	12
Student 5	6	7	7
Student 6	13	12	13
Student 7	9	9	10
Student 8	7	6	8
Student 9	9	10	10
Student 10	6	6	6
Student 11	11	12	14
Student 12	10	12	12
Student 13	13	13	14
Student 14	16	16	16
Student 15	8	9	10
Student 16	5	4	6
Student 17	11	13	13

Student 18	15	15	17
Student 19	11	10	10
Student 20	9	11	10

Table 3

Control Group Post-Test Sit and Reach

Control Group	**4/16/2003**	**Post-Test**	
	Reach One	**Reach Two**	**Reach Three**
Student 1	5	8	9
Student 2	10	8	10
Student 3	4	5	5
Student 4	11	11	11
Student 5	7	8	9
Student 6	11	12	14
Student 7	9	9	12
Student 8	4	5	6
Student 9	10	9	10
Student 10	5	7	8
Student 11	10	10	11
Student 12	9	11	11
Student 13	12	13	13
Student 14	15	16	17
Student 15	9	10	11
Student 16	5	5	6
Student 17	12	12	12
Student 18	15	12	15
Student 19	11	11	10
Student 20	9	10	11

When looking at the results, one notices that there is little or no change in the pre- and post-test results. The results for the experimental group are are presented in Table 4 and Table 5. (Again, names are not revealed to protect the participants).

Table 4

Experimental Group Pre-test Sit and Reach

Experimental Group	**3/18/2003**	**Pre-Test**	
	Reach One	**Reach Two**	**Reach Three**
Student 1	15	13	14
Student 2	8	12	12
Student 3	11	11	12
Student 4	11	11	12
Student 5	10	10	10
Student 6	11	11	11
Student 7	9	9	9

Student 8	11	12	14
Student 9	10	10	10
Student 10	9	11	10
Student 11	16	16	15
Student 12	12	13	13
Student 13	17	18	18
Student 14	13	13	15
Student 15	12	10	12

Table 5

Experimental Group Post-test Sit and Reach

Experimental Group 4/17/2003 Post-Test

	Reach One	Reach Two	Reach Three
Student 1	16	15	15
Student 2	10	12	13
Student 3	12	12	13
Student 4	11	12	12
Student 5	11	11	12
Student 6	11	12	14
Student 7	10	10	9
Student 8	15	16	15
Student 9	12	12	11
Student 10	10	11	10
Student 11	16	17	16
Student 12	13	13	13
Student 13	18	18	18
Student 14	14	15	15
Student 15	12	11	13

As expected, there was a difference between the control group and the experimental group; the control group retained the same average and the experimental group had a slight increase in results after only 1 month of active stretching. The results for the experimental group did not have a significant increase in pre- to post-program flexibility; even though the program only ran for 1 month, there was a small, but noticeable, increase. The increase in the experimental group ranged from 0.3 to 3 inches, with every person involved showing improvement. The comparative data is presented in Figure 1 and Figure 2.

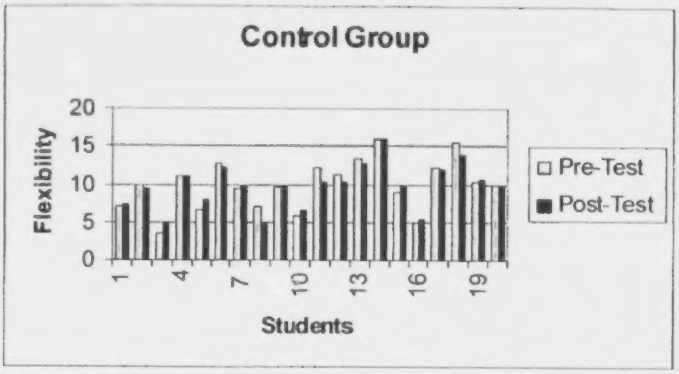

Figure 1. Control group comparative data on sit and reach.

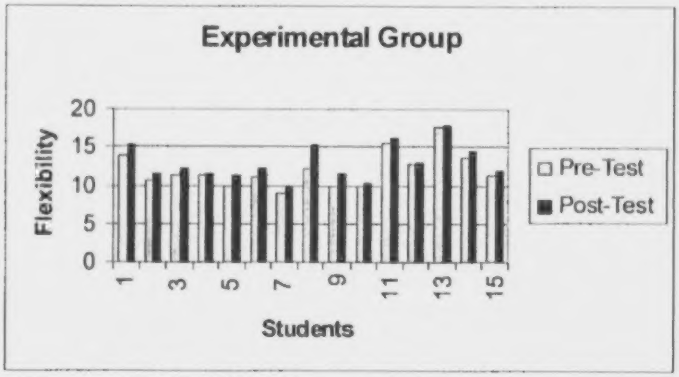

Figure 2. Experimental group comparative data on sit and reach.

As illustrated above, there was 100 % of the students in the experimental group showed improvement. The control group had varied results, with some students showing slight improvement, some remaining the same, and others declining. Overall, the control group's mean reach in the pre-test was 10.7, and the mean reach in the post-test was 10.6, showing that without the stretching routine, absolutely no improvement was achieved. The mean for the experimental group's pre-test was 12.6, while the mean for their post-test was 13.6. Finally, an interesting feature of the data is that, despite random assignment, the control group had significantly less range of motion than the experimental group at pre-test. Yet, even with the difference in the range of motion, the data patterns suggest that stretching improved range of motion toward the experimental group's level.

Conclusions and Recommendations

Stretching the legs and lower back, three times each week, for 1 month improves the lower body's range of motion. The improvements were not ground-breaking but they were visible and observable. In order to properly complete this study, one would need to carry out the research over a longer period of time, check the flexibility rates after each month for 6 months, and chart the improvement of the students over a significant period of time. I do not believe grant money would be provided or needed for this particular study because it is fairly void of expense. Technology is already in use during this study in order to chart the improvement of the people involved, and keep a record of the data.

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Copies of Instruments

The instrument used was the sit and reach test which cannot be put on paper, but is described in the above pages.

TOTAL PHYSICAL RESPONSE STORYTELLING AND VOCABULARY RETENTION IN SECOND LANGUAGE LEARNING

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Introduction

It is generally accepted throughout Western societies that the knowledge of, and the ability to use, a second language is a skill of great value. Those who are able to speak more than one language have opportunities for experiences and learning that are harder to obtain by those who do not carry this ability. Taking this fact into consideration, many schools are now requiring their students to study a foreign language. However, many of these students leave their studies unable to remember what they once learned, much less able to communicate effectively in the second language. Most of these students were taught the foreign language by classical methods such as drill and practice and rote memorization of contextual vocabulary. In an effort to impart more learning, educators have been working on various methods of instruction based upon more student-centered approaches and multiple learning styles. The Total Physical Response Method (TPR) is one such practice that was developed by James J. Asher during the 1960's, and based upon the kinesthetic model of learning styles from Gardner's theory of multiple intelligences. As a potential educator, I am interested in this method as it seems to produce a greater competency in target language use by students being taught under the TPR method, and it coincides with my ideals for a classroom environment conducive to learning. Judging from my time spent both as a student and as an observer in foreign language classrooms, I have noticed a lack of usage of TPR by educators. As I have begun to research various sources for information regarding this method, I have been surprised at the general paucity of action research on TPR despite the many accolades for its benefits.

Statement of Problem

Since I have decided to become an educator, I've become concerned about how my future students will learn Spanish, and what the best ways to teach them will be. I have read a great deal about the strategy created by James J. Asher, known as the Total Physical Response Method, which is based upon the premise that movement somehow creates connections between the material being studied and its recall for later use. An offshoot of TPR developed by Blaine Ray (1990) is known as TPR-Storytelling, or more commonly, TPR-S. TPR-Storytelling utilizes the same guiding principle of kinesthetic learning, but it goes a step farther by incorporating mini-situations and stories that often have a bizarre plot. The stories are catchy due to their novelty and brevity. Vocabulary is taught through gestures that are mimicked by the learners. Grammatical structure is implicitly taught through the storyline.

During most of my observations in area schools, I have witnessed only one teacher who uses the method as her primary means of instruction. This particular educator is very enthusiastic about the higher levels of language use and grammatical understanding her students produce. The students I observed in her classroom seemed to be entertained and engaged in what they were doing in her class, something I believe all educators would strive for! If students stand the chance of learning more of the target language in a more efficient and engaging way, why are instructors not using it? Perhaps it is due to the novelty of the method, a lack of training or interest, or maybe even resistance to change. Regardless, it seems to be an underused opportunity to teach students what it is we, as educators, want them to learn.

In my reading of the literature regarding TPR and TPR-S, and their use in the foreign language classroom, I noticed a rather obvious lack of any comparative studies between students being taught with TPR methodology and those being taught with traditional techniques. Therefore, what I hope to focus on during my research is just such a comparison between the TPR-S Method and the strategies typically employed in foreign language study. My proposal is that if students are instructed using TPR-Storytelling, they will show greater achievement than a similar group of students whose instruction does not include using the TPR-Storytelling Method, as evidenced by performance on a vocabulary retention test.

Review of the Literature

In school systems all across the country, the study of foreign languages is gaining in importance due to the increasingly global situations in which our society finds itself. Foreign language education professionals are concerning themselves with making their subjects accessible to all types of learners. This attention to learning styles stems from Howard Gardner's research on multiple intelligences (MI) and the effect has been an implementation of new techniques in classroom instruction that tap into these various modes of learning. One of the intelligences labeled by Gardner is that of "bodily kinesthetic," that rests on the premise that through bodily movement, learning occurs. The instructional method used in conjunction with this belief is known as the Total Physical Response Method (TPR) which was developed by James J. Asher in the 1960's. The introduction of TPR represented a revolutionary departure from the audiolingual practice of students exercising rote memorization of the target language as modeled by the teacher. In the TPR classroom, the use of novel commands actively engages students in the learning process. The basic premise then is that listening comprehension precedes speaking. According to Asher (1977), "…not only is listening comprehension essential to the development of speaking, but it is acquired in a particular way, namely through the relationship between the language and a child's body." An important aspect for the development of listening comprehension, according to Asher's TPR Method, is the "silent period" in which students aurally take in the foreign language without pressure to immediately orally reproduce it, much in the same way infants and toddlers are exposed to and learn their native languages. This lull in oral production is a benefit often touted by researchers. According to Cantoni (1999), "The silent period creates a less stressful environment, and the method also utilizes a great deal of [Vygotsky's] scaffolding techniques, both of which are very important to language acquisition." An important facet of the use of commands in the TPR Method is that they be comprehensible. This requirement of comprehensibility is derived from the theories of Stephen Krashen's (Krashen & Terrell, 1983) input hypothesis that states that, "Language is acquired when the input (or message) is understandable and meaningful to the learner." Support for the basic tenet of the input hypothesis can also be found in the literature. In a study conducted on the effects of instructional conditions on students' vocabulary retention, Kitajima (2001) found that the experimental subjects retained and used more of the target language vocabulary under an output condition in which the context was meaningful and the content purposeful to the students- -two conditions fostered by the use of the TPR Method.

The Total Physical Response Method, though popular for its novel approach, is not without criticism from the field of language acquisition research. Cantoni (1999) has made comments regarding areas of concern with the strategy, stating, "TPR has been proven very effective for the initial stages of second language instruction, but it has limited usefulness for advanced learning; it is predominantly teacher initiated and directed with little opportunity for student creativity and little attention to individual interests." Other researchers cite the lack of instructional tools for the teacher, stating that, "...explicit curricular guidelines and teaching materials for utilizing TPR remain to be developed," (Glisan, 1986). In addition to these concerns, Glisan (1986) remarks that, "TPR cannot easily be used to teach the abstract, and the exact techniques for presenting reading and writing are still unclear."

Perhaps in response to such criticisms, an outgrowth of TPR, known as TPR Storytelling (TPR-S) was developed by Blaine Ray (Ray & Seely, 1997). TPR Storytelling makes use of novel and simplistic storylines that aurally immerse the learner in the vocabulary and grammatical structure of the foreign language. Explicit grammatical instruction is minimal and used only in special circumstances, as during the course of instruction, as the stories become more complex in both contextual vocabulary and grammar. In his book, Blaine Ray (1997) makes the statement, "A very high percentage of the language is acquired and not learned. The study of grammar rules does not aide in the acquisition of the language. Language is acquired when learners have a *feeling of correctness* about it." Blaine (1997) also declares, "This feeling of correctness comes from hearing and understanding the target language." The storylines can be manipulated to use the students' names and their life situations to make them more meaningful, and therefore, more interesting to the learners.

Due to the recency in the development of TPR-S, one encounters a scarcity of research literature concerning its use in the classroom. However, the successes of the TPR Method bode well for the future of TPR-Storytelling and encourage further exploration into its capabilities and use in the classroom.

Methodology of Research

Population

Seven classes of beginning Spanish learners in a public secondary school located in the suburbs were used as subjects for this study. The experimental group consists of four classes that receive second language (L2) instruction solely through the TPR-S methodology. The control group consists of three classes that receive instruction in the L2 through traditional teaching strategies such as drill and practice, worksheets, and textbook use. The study focuses on the experimental group and their retention of previously studied vocabulary as based upon an exam to be taken by both groups. This study attempts to give additional information to those who teach foreign languages at the secondary level and find a lacking of comparative research among groups exposed to different methods of instruction.

Measurement

The intent of this study is to determine whether students who are exposed to the TPR-S Method of foreign language instruction show higher achievement in the retention of vocabulary words previously studied in the academic year. The experimental group receives classroom instruction solely in the TPR-S form. The control group receives instruction using traditional methodology. The same teacher for the duration of the research will instruct the experimental group. The same teacher for the duration of the research will instruct the control group. The teachers will not be the same for both groups (due to proficiency in using the TPR-S method). The scores made by the students on an exam will determine learners' retention of vocabulary. The scores of each group will be averaged and compared.

Procedure

This study began during March 2003 in a public secondary school located in the suburban Chattanooga area and lasted approximately 2 weeks. Seven classes of beginning Spanish students were used as subjects. The experimental group consists of four classes receiving instruction using only TPR-S, while the control group consists of three classes receiving instruction using more traditional strategies. Both groups were given a vocabulary exam that consisted of terms that had been studied at the beginning of the academic year. The testing instruments were *not identical* (Appendices A and B) for both groups due to the vocabulary taught by their prospective teachers. In an attempt to measure true retention, there was no review period prior to the administration of the exam.

Data Results & Analysis

Each group was administered a 40-item matching quiz consisting of vocabulary words taken from lessons at the beginning of the academic year. The tests were scored for the number of items that were incorrectly marked by the test subjects. Incorrect items were grouped by the number missed: 1-5, 6-10, 11-15, 16-20, 21-25, 26-40, and lastly, perfect score. The total number of tests that fell under the appropriate category was tallied for each of the seven classes. The total number of tests scored between the two groups was 157. Table 1 shows the data results for both groups.

Table 1. Questions Missed, by Group

Group Name	1-5missed	6-10missed	11-15missed	16-20missed	21-25missed	26-40missed	Perfect Score	Total Tests
Experimental	46	13	14	0	2	1	11	87
Control	41	8	5	3	0	1	12	70
Group Totals	87	21	19	3	2	2	23	157
	Percentage of Group		Data Rounded to Nearest Whole Number					
Experimental	53%	15%	16%	0%	2%	1%	13%	
Control	59%	11%	7%	4%	0%	1%	17%	

Overall, the results for both groups are quite similar; however, the control group appears to have performed slightly better on the task. From the control group, 59% returned tests with 1-5 items incorrectly marked; 17% made a perfect score. The experimental group returned 53% of the tests with 1-5 items incorrect, while 13% made a perfect score.

Conclusions

My initial hypothesis concerning this research was that students who receive foreign language instruction using the TPR-Storytelling Method would retain more vocabulary than students who receive instruction through more traditional means. However, the results from this study indicate that students in the experimental group performed *less well* than those from the control group. Several factors may contribute to this. Primarily, in classrooms that utilize TPR-S, students are rarely assessed using instruments such as the one used in this study. More often, they are given performance tasks and oral assessments and as such, may perform less well on print-based assessment situations with no aural input or visual cues from the instructor. Yet another obvious factor may be the differing test instruments used in this study.

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Despite the indication by the results of a rejected hypothesis, I still feel as though the students in the TPR-S classroom have a more enjoyable, relaxed, and therefore, a more productive experience with learning another language. Also, since there is only a slight difference between the groups, I feel this would warrant further investigation into the problem by other professionals. Another conclusion to be drawn here is that, perhaps, in relation to their professional development, teachers would be wise to become familiar with the strategy and employ it in their classrooms. Workshops for educators are scheduled year-round, and some districts may have funds allocated for such resource development. The role of technology's use in the TPR-S classroom has yet to be fully explored. I feel this is mainly due to the nature of the strategy being that it utilizes orally-told storylines and physical manipulation of the learners.

Research Testing Instrument

Appendices A and B

The following vocabulary tests were developed to assess retention of previously studied vocabulary in a beginning Spanish class. The lists are different for both the experimental and the control groups due to the different teaching strategies employed by the instructors. These instruments will be used to determine whether or not students exposed to TPR-S versus traditional teaching strategies perform better on vocabulary retention tasks. The items are taken from lists of vocabulary used in each groups' respective class. Form A is for the control group and Form B is for the experimental group.

Appendix A. Form A for Control Group

Matching: Select the correct English translation for the Spanish words/phrases on the left. Please write the letter of the correct response in the blank. ***Not all options will be used!***

1. _____una limonada
2. _____la fecha
3. _____martes
4. _____enero
5. _____un cuaderno
6. _____un libro
7. _____una mochila
8. _____una silla
9. _____una pizarra
10. _____una computadora
11. _____hasta luego
12. _____por favor
13. _____la hermana
14. _____la clase
15. _____el curso
16. _____la química
17. _____pequeño
18. _____grande
19. _____inteligente
20. _____interesante
21. _____fácil
22. _____difícil
23. _____el mediodía
24. _____la medianoche
25. _____la sala de clase

a. brother
b. please
c. kitchen
d. when?
e. to study
f. the date
g. a book
h. to teach
i. see you later!
j. interesting
k. a backpack
l. enter
m. Tuesday
n. chemistry
o. the curse
p. a chair
q. January
r. a lemonade
s. a (chalk)board
t. the class
u. little
v. intelligent
w. snack
x. to go
y. difficult

26. _____la lección

27. _____la nota

28. _____el coche

29. _____estudiar

30. _____mirar

31. _____enseñar

32. _____cuándo

33. _____la cocina

34. _____la merienda

35. _____la fiesta

36. _____la trompeta

37. _____la biblioteca

38. _____la tienda

39. _____cantar

40. _____ir

z. a notebook

aa. a computer

bb. classroom

cc. big

dd. Mars

ee. midnight

ff. easy

gg. sister

hh. grade

ii. to look at/watch

jj. store

kk. car

ll. the course (as in a class)

mm. trumpet

nn. noon

oo. party

pp. to sing

qq. bookstore

rr. lesson

(Form A)

Appendix B. Form B for Experimental Group

Matching: Select the correct English translation for the Spanish words/phrases on the left. Please write the letter of the correct response in the blank. *Not all options will be used!*

1. _____ los calcetines
2. _____ próximo
3. _____ mismo
4. _____ gasta
5. _____ el dinero
6. _____ la dependiente
7. _____ suficiente
8. _____ ayuda
9. _____ cuenta
10. _____ obtiene
11. _____ ladrón
12. _____ se pone
13. _____ vuela
14. _____ por la calle
15. _____ falda
16. _____ le gusta
17. _____ rompe
18. _____ sucia
19. _____ venden
20. _____ llega
21. _____ encuentra
22. _____ piensa
23. _____ le queda
24. _____ el boleto
25. _____ la oficina
26. _____ tanto
27. _____ pierde

a. the bowl
b. gets dirty
c. everywhere
d. returns
e. skirt
f. boring
g. brings
h. the pieces
i. while
j. socks
k. the money
l. puts on
m. enough
n. clerk
o. different
p. so much
q. punishes
r. next
s. crashes
t. fixes
u. thinks
v. remains/stays
w. through the street
x. loses
y. leaves
z. arrives
aa. office

28. _____ viene
29. _____ le pregunta
30. _____ cada
31. _____ recuerda
32. _____ choca
33. _____ vuelve
34. _____ el tazón
35. _____ los pedazos
36. _____ por todas partes
37. _____ se ensucia
38. _____ trae
39. _____ mientras
40. _____ castiga

bb. remembers
cc. flies
dd. asks him/her
ee. same
ff. spends
gg. sell
hh. dirty
ii. finds
jj. breaks
kk. thief
ll. counts
mm. helps
nn. ticket
oo. gets/obtains
pp. she/he likes
qq. under
rr. each
ss. comes

(Form B)

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THE USE OF MNEMOMIC DEVICES IN THE TEACHING OF MATHEMATICS IN MIDDLE SCHOOL: WHAT A GROUP OF EIGHTH GRADERS REMEMBER THAT HELP THEM SOLVE MATH PROBLEMS

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Introduction

Although there may be many reasons why students have difficulty understanding and performing at a satisfactory level in some subjects, many students, for a myriad of reasons, have difficulty mastering a core subject like mathematics. This paper proposes that there are many effective mnemonic devices used to provide students a means of overcoming objections heard concerning mathematics. Mnemonic devices are the teacher's means of assisting students in remembering the steps of mathematical processes and formulae; their learning mnemonics increases a student's memory bank, upon which he may draw to improve his ability to successfully solve mathematical problems. Mnemonic devices offer an important vehicle to present and introduce fun and enthusiasm in the classroom. Anticipation of attending a class which mixes fun and entertainment with important lessons has the potential for relaxing the student, reducing the "fear of failure," reducing nervousness, and creating a heightened interest and curiosity which may be highly complementary to the learning process (Stephenson & Stigler, 1992). My own experience indicates an increased desire to understand, and a new motivation to perform, at a higher level than previously, offering the student a means, incentive, and opportunity to gain new and broad insights into the universal applications of mathematics. Any increased interest, enjoyment of the school day, and desire to learn helps allay the often heard, repeated fear when pupils say, "I hate math, it's so hard." Perhaps with the use of a full array of jingles, rhymes, sayings, and the many other unique connections offered by mnemonic devices, teachers may hear, "it's not so hard after all," and once learned and locked-in with a mnemonic device, the teacher may hear, "it's easy?" This project proposes an assignment to pretest students regarding their knowledge and use of mnemonic devices felt helpful and useful in several branches of mathematics.

Statement of the Problem

Various studies in recent years have shown that mathematics achievement test scores of America's K-12 public school children lag significantly behind many Asian and European students (Hirsch, 1996). It is suggested that the uniform teaching of the mnemonic devices of mathematics may be an effective tool mathematics teachers can use in the effort to improve American students' scores. This research attempts to collect some of the mnemonic devices used in mathematics and use them to pretest a sample of approximately 100 middle school students to determine what they know, how much they know, and how and when they learned it.

Review of Literature

A review of the literature is only one source of mnemonic devices collected in this paper; also included are the results of interviews and discussions with teachers and students, along with my personal recollections of useful mnemonic devices learned over 50 years. The literature is significant but scattered. I've found no collection of mnemonic devices; they occur as rhymes, acronyms, metaphors, analogies, associative memory devices, and items which I designated as just pure old fun stuff for the adolescent.

Mnemonic Devices

An exercise which helps answer the questions young people seem to always ask in the early stages of an algebra class is a simple "mind drill." The questions come:

1. What good is this stuff?
2. Why do we need to know how to manipulate all these A, B, C's and X, Y, and Z's?
3. Will knowing how to do this get me a job?
4. How will I use what I'm learning on my job?

The answers teachers give are sometimes of an imprecise, vague, and nebulous nature, e.g., algebra trains one to think and work in terms of an orderly process; or the algebra training is the prerequisite for the more complex and advanced branches of mathematics; or learning to apply the rules of algebra in a carefully crafted, written manner allows one to solve highly complex problems that are normally beyond the limited memory, restrictive manipulative abilities, and arithmetic process limitations of the human mind. To demonstrate and impress the class in seeing how the mind is overloaded and unable to immediately see the reasoning and answer to a simple first order algebraic equation, the following instructions can be issued to the entire class: "No talking to anyone, please, do not utter a sound until I say that you may speak! You may do this in your head, but you may make fewer mistakes if you work on a piece of scrap paper. Ready? Think of a number between 1 and 10, inclusive, and hold it in your mind; multiply by 2; now add 8; now divide everything you have by 2; now subtract the number you first held in your mind from the number you now have. Now associate the number you have calculated with the alphabet - A is 1 and Z is 26. Got a letter? Now think of country beginning with that letter, probably over in Northern Europe somewhere. Got a country? Now advance one letter in the alphabet; if you have A go to B; if you have X go to Y. Got a new letter? Finally think of a large animal in the world beginning with that letter and it's color. Now, I'd like to ask you class, why do you always calculate **the number 4**, select the corresponding **letter D,** think of the **country Denmark** and **elephants colored gray**? Why do you do that?" This exercise usually eliminates any future questions of the type written above, and it is not unusual for the good student to ask for more algebra problems of this ilk.

I first heard this example demonstrating the value of algebra in 1953 from Professor H. Brown who taught Engineering Problems and the use of the slide rule at The University of Tennessee, Knoxville, TN. His automobile was easy to identify; the license plate number was 3 - 1416.

For interested students, the teacher writes the following equation on the board; many seventh and eighth graders are able to solve the equation in three steps and see that 4 is always the calculated number, no matter which number they select from 1 to 10, inclusive, e.g.,

$[(X \times 2) + 8] / 2 - X = (2X + 8) / 2 - X = X + 4 - X = 4$ **(always, for any value of 1-10, inclusive).**

Students often confuse the definitions and meanings of the six trigonometric functions. They indeed must remember the names of the six functions as sine, cosine, tangent, cotangent, secant, and cosecant; he/she then must draw an equals symbol and the fractional bar after each. Then recalling that the side opposite the reference, acute angle of a right triangle is designated the O side, the side adjacent to the reference, acute angle is designated the A side, and the remaining sloping line is the hypotenuse of the triangle, and is designated with an H. The figure below shows the side designations.

Insert Figure

Now all one must remember is the letter sequence O, A, O, A, H, H. Beginning on the numerators, write these letter symbols, proceeding vertically downward; when you get to the bottom, start back to the top, writing the letter symbols on the denominators in the same sequence as before. Following these instructions, the student is able to quickly write the six trigonometrical ratios on the corner of his test paper and avoid ever being confused as to their meanings.

Sin = O/H

Cos = A/H

Tan = O/A

Cotan = A/O

Sec = H/A

Csc = H/O

This method of remembering the six trigonometrical relationships was taught to me by Dr. Winston Massey, Mathematics Department Head, The University of Chattanooga, 1956. Since students soon recognize, and many are taught, that the lower three of the trigonmetrical functions are simply the reciprocals of the upper three, i.e., the cotangent is the reciprocal of the tangent, the secant is the reciprocal of the cosine, and the cosecant is the reciprocal of the sine, and because of this, they may soon be content to remember the first three definitions of the ratio of sides of the right triangle and just need a way to remember the first three. Students can be taught to remember **Princess SOH-CAH-TOA** (Flansburg & Hay, 1994).

When working with triangles, the solution involves the square root of numbers. The square root of 2 and the square root of 3 are often encountered and should be memorized in some manner (Debold & Rogalski, 1998). The square root of 2 is (counting the number of digits): **I wish I knew** (1.414); the square root of 3 is: **I thought you do** (1.732) - the year 1732 is also the birthyear of George Washington.

The value of pi to seven places (Schrock & Morrow, 1993): **May I have a large container of coffee** (3.1415926)?

The ascending value of Roman numerals 50, 100, 500, and 1000 is (Vorderman, 1996): **Lucky Cows Drink Milk** (L, C, D, M).

One of the most important mnemonic devices a student must learn if he is to be successful in solving complex algebraic expressions is a means to know and recall the order of operations. This is done by remembering **Please excuse my dear Aunt Sally** (Schrock & Morrow, 1993). This, of course means the student is to, in sequence, evaluate and remove the **Parentheses**, then evaluate the **Exponents**, then **Multiply**, and **Divide** from left to right, then **Add** and **Subtract** from left to right.

I now propose to develop a pre-test for eighth graders based on the foregoing mnemonic devices of mathematics, then analyze and report results this being the goal and objective of the research. The pre-test is contained in Appendix A.

Data Collection and Results

Tallying Responses

Block 2	Number on Roll	Students Present
	27	23
Block 5	Number on Roll	Students Present
	26	20
Block 6	Number on Roll	Students Present
	27	22
Block 7	Number on Roll	Students Present
	27	15

Question No.	Number of Positive Responses (of 80 assessed)
1	50
2	required a written/oral response
3	and was only indirectly
4	related to mnemonic devices
5	65
6	65
7	60
8	60
9	50
10	70
11	5
12	2
13	0
14	5
15	0
16	50
17	60
18	2
19	0
20	4

(see Figure 1).

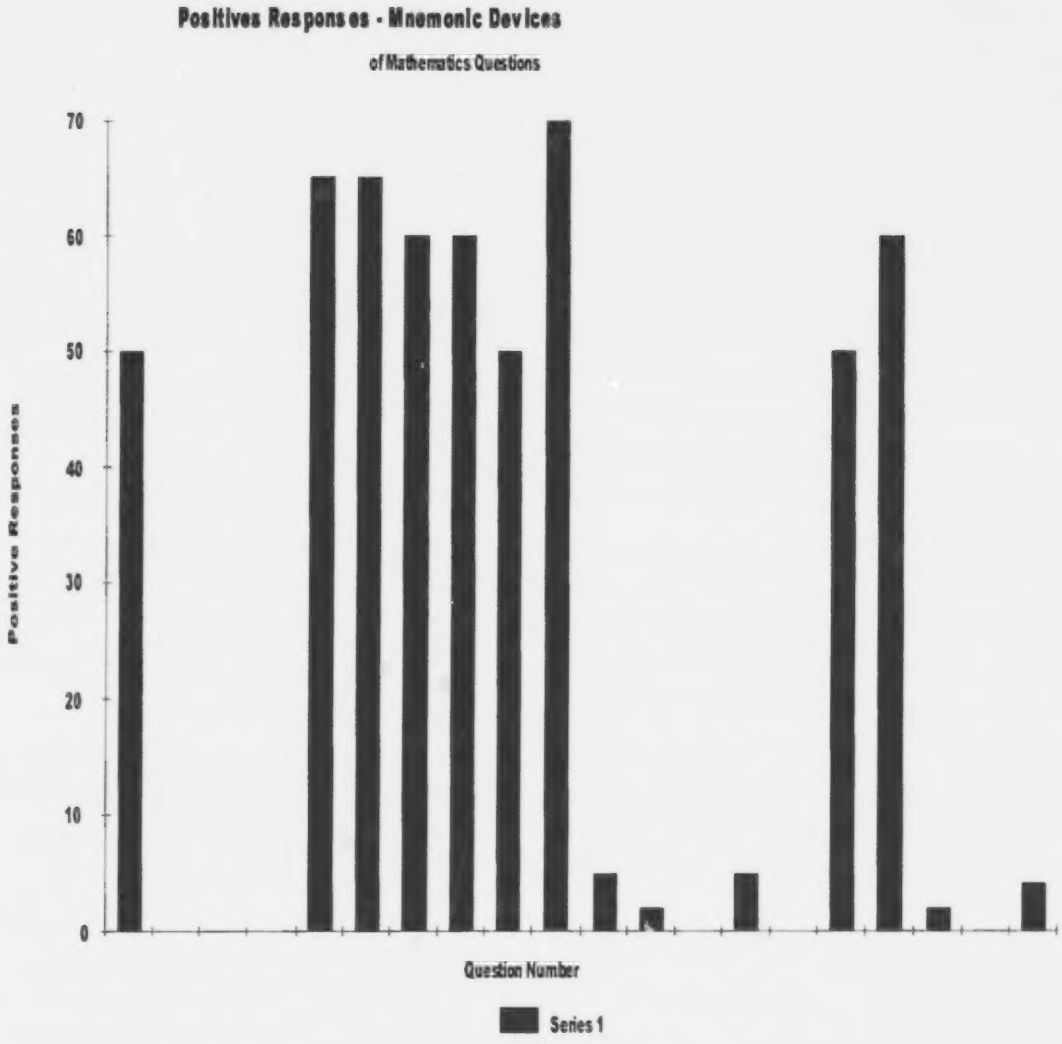

Figure 1. Positive responses to pre-test questions.

Report of Student Responses

Questions no. 1 through 4 asked general questions that were not directly related to the mnemonic devices of mathematics. Question no. 1 asked if students were aware that East Asian and European students routinely scored higher on tests than American students K-12. In a discussion, students said "yes," they had heard that, but none seemed too concerned that this was so or wanted to know why.

Question no. 2 asked why they thought Americans do not do so well on tests when compared with other students in East Asian and European countries? One student told me, "we don't see how algebra is going to be useful, or help us when we get out of here, we had rather use the time to sing and dance and develop socially." Another student said, "look around, we don't even have no computers like other schools, how can we learn?" Another student said, "I want to learn, but there is so much noise and people doing crazy things that it is difficult and I don't have enough individual time with the teacher." I remember asking one young lady who I had observed did not disturb the class, but did not follow instructions, nor would she get out a sheet of graph paper or sharpen a pencil, if she wanted to learn and pass algebra. She "yes," she wanted to pass, and told me "I made a C on my last progress report." I explained that I was conducting tutoring after school from 2:30 p. m. to 3:30 p. m. 2 days this week, and asked if she would like to come. She told me, "I don't stay after school for nothing, I got things to do."

Question no. 3 asked if they thought the middle school learning of math was very important. A large portion of the class responded positively, but several clarified their position by saying, "but we don't see much use for algebra."

Question no. 3 asked the individuals to circle their latest grade in mathematics. I assume most would have circled a passing grade, else how would they appear in an algebra class? I found it difficult to believe all 80 of these students in four blocks were passing since 30% failed the first test I had administered.

Questions no. 5 through 9 were all related to "please excuse my dear Aunt Sally." Questions 5 & 6 asked if they had heard the question and knew what it meant. Eighty-one percent reported they had heard the expression and, by their answers to questions, I was convinced the same 81% had a working knowledge of the meaning. Questions 7, 8 & 9 dealt with where the device was learned, when was it learned, and who taught it. Seventy-five percent of respondents said they learned the device in middle school and 25% said they learned it in either 5 or 6th grade but most could not remember the name of the teacher who taught them. Sixty-three percent of those canvassed said they thought they did not learn the device at this middle school, but could not remember where they learned it or from whom.

It was refreshing to find that 88% knew the correct answer to no. 10, that the square root of 16 is 4; it was also not surprising, since none had taken plane geometry, that only 6% knew that 1.732 was the square root of 3 (no. 11) and only 2.5% had been taught a way to remember the often encountered square root of 2 and 3 (no. 12). Consequently, it was not surprising that no one said they had ever been taught how to calculate the square root of a number (no. 13). One young lady told me that she thought the only way to do it was with a calculator. I asked a math teacher about this and was told the teacher didn't know how to do it and thought it was no longer taught in middle school. Allowing only a minimum length of time for an answer, only 6% were able to promptly report 13 was the square root of 169 (no. 14). No one had ever heard that the square root of 2 is "I wish I knew," (no. 15). Since we were studying the equation of a straight line, it was encouraging to find 63% knew that the opposite/adjacent sides of a right triangle is the same as the rise/run (no. 16); 75% recognized that the definition of rise/run was learned in this algebra course and was taught by this teacher (no. 17).

None of this class has studied trigonometry, so it was not unusual that only 2.5% recognized that the rise/run was also equal to the tangent of the acute angle (no. 18) and none were familiar with "lucky cows drink milk" as a way of remembering that, in Roman Numerals, L = 50, C = 100, D = 500, and M = 1000.

Since I had told this "story" to some students in the after school tutoring class, 6% knew the story (no. 20). The story (also detailed on above): instruct the class to be absolutely silent during this entire exercise, please. Think of a number between 1 and 10, inclusive, and hold it in your mind. Multiply by 2; now add 8; now divide everything you have by 2; now subtract from what you now have, the number you first held in your mind. Now associate the number you have calculated with the alphabet; A is 1 and Z is 26. Now associate the letter you have selected with a country (maybe over in Northern Europe somewhere). Now advance one letter in the alphabet ; if you had A, go to B, if you X, go to Y. Now associate the letter you have with a large animal, and think of its color!

It is fun to ask students why they always calculate the number 4, associate it with the letter D, the country Denmark and elephants colored gray - this is 8th grade algebra; the equation is shown on page 9, question 20. For some, I was told this became a reason for reconsidering their valuation of algebra.

Conclusions

Since this paper is an adaptation of an earlier research paper prepared in Education 500, and since the collection of some of the mnemonic devices are applicable to mathematics courses not yet undertaken by eighth graders, it is reasonable that they would not be familiar with some of the mnemonic devices. Consequently, it was expected that eight grade students would not do very well in answering/responding to all 20 questions in a satisfactory manner.

The current class work of the 80 students involved in this study was that of studying the various mathematical aspects of a straight line. I was pleased to see that students were familiar with "please excuse my dear Aunt Sally" because it is at this very point in their study of algebra that students must demonstrate their skill in algebraically manipulating the linear equation, converting it from how they find it to the standard form of $y = mx + b$ and accurately plotting the line(s) on graph paper. Other than learning how to visually determine the slope and mathematical direction of a line, students also learned how to calculate the slope and mathematical direction of a line using the coordinates of two points on the line. Students became familiar with the term y-intercept and understood the term to mean the value on the y axis where the line intercepts the y axis; they became proficient in the use of quadrille graph paper, the careful use of the straight edge and pencil, and were introduced to the formula for a straight line: $y = mx + b$. Converting the formula for a straight line from the various forms in which it may be found to the standard form seems to be the most difficult aspect of the linear algebra for eighth graders. Not only must they become experts in multiplying, adding, subtracting, or dividing both sides of the equation in order to simplify the expression, they are required to accomplish the work without making sign errors or errors in the various algebraic procedures. I felt the "please excuse my dear Aunt Sally" was very helpful, if not essential, in the student being able to master this phase of linear algebra.

I was intrigued that students had the basic understanding of the meaning of the squaring of a number and the square root of a number. At the same time, they were lost in having any procedure to determine the square root of a number other than recalling a few common, memorized solutions and/or a developing a solution by "trial and error," i.e., try a number, square it and see how close you can get. Most surprising to me was the remark by one child, who said, "the only real way we have been taught to get the square root of most numbers is with the use of a calculator; we need calculators to find the square root of numbers." I thought, It's such an easy arithmetic procedure, I'm surprised it isn't taught - I remember how to do it, although taught it over 50 years ago. I was really floored that a math teacher did not know how to calculate the square root of any number.

It is my opinion that this paper is only partially age appropriate for eighth graders; the teaching of the mnemonic devices appears to be more appropriate to be taught at the 10th or 11th grade level.

Recommendations

It is suggested this subject may interest other researchers, who may be motivated in uncovering, revealing and collecting additional mnemonic devices as well as developing more extensive studies for determining their value held by teachers and the students of mathematics. Perhaps some should be considered as an important component of the mathematics curriculum?

For those who may want to teach children how to determine the square root of any number (without a calculator), here's the procedure as I learned it 50 years ago: Let's say we want to determine the square root of 644.00

Step 1: we separate the digits in groups of 2, on each side of the decimal point; e.g.
6 44.00 00 00

Step 2: we ask ourselves, what is the largest square in 6; answer is 2; we place the 2 above the 6, and subtract the square of 2 (4) from 6 and bring down the next two digits; e.g.

2
6 44.00 00 00
4
____
2 44

Step 3: this is the point where some become confused, i.e., determining the trial divisor. It's done as follows, multiply the quotient (2) by 2 and add a zero; then replace the zero with the number whose product of the trial divisor times the new digit of the quotient does not exceed the dividend or

40 | 244
or
45| 244 and 5 x 45 = 225; so now we have:

2 5.
6 44.00 00 00
4
__
45 | 2 44
2 25
____
19 00 continuing the same procedure; multiply the quotient by 2, add a zero and then replace the zero by a number whose product of the number times the new trial divisor does not exceed 1900; e.g.,

500 | 1900
or
503 | 1900; so now we have:

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```
        2 5.  3  7  7
        6 44.00 00 00
        4
       __
45 |  2 44
      2 25
     _____
503 |   19 00
         15 09        and this continues to achieve the accuracy desired
       ______
5067 |   3 91 00
          3 54 69
        ________
50747|    36 31 00
           35 52 29
        ___________
               78 71
```

Check: 25.377 x 25.377 = 643.99213

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Appendix A. A Pre-test To Determine How You Remember Mathematical Procedures **February 2003**

Note: This is a voluntary pre-test to determine several things about your learning of mathematics; do not write your name on the paper; you are to remain anonymous. Thank you for your participation. Fill it out quickly and turn it in to your teacher.

1. Are you aware that Asian and European students routinely score consistently higher on math tests all the way from K through 12th grades?

   Please circle yes or no.

2. If you answered yes to no. 1, what do you think is the problem? Please circle your answer if it is seen below. If you don't see a reason, please write in your own reason.

   noise & poor classroom discipline   poor teachers   students are not motivated and don't care

   school materials inadequate   school facilities inadequate   we should be learning the computer

   not enough individualized time with the teacher   I get no help with the homework

3. Has your experience in middle school convinced you that learning math is very important?

   Please circle yes or no.

4. Please circle your latest grade in mathematics.

   A   B   C   D   F

5. Have you ever heard this: "Please excuse my dear Aunt Sally?"

   Please circle yes or no.

6. What does "please excuse my dear Aunt Sally" mean?

   Please write the answer in your own words

7. Did you learn "Please excuse my dear Aunt Sally" at this middle school?

   Please circle yes or no.

8. If your answer to no. 7 is yes, when did you learn it and who taught it to you?

-8-

9. If your answer to no. 7 is no, when and where did you learn it?

10. If you understand the meaning of square root, please circle the correct answer to the square root of 16?

    2   2.5   3   3.8   4   4.2

11. The square root of numbers like 2 & 3 often occurs in mathematics. Please circle the square root of 3.

    1.414   1.5   1.732   1.8

12. Have you ever been taught a memory device that allows you to remember the square root of 2 or 3?

    Please circle yes or no.

13. Have you ever been shown how to calculate the square root of a number?

Please circle yes or no.

14. If your answer is yes, please circle the answer to the square root of 169.

9 10.6 13.0 14.2 16

15. Has anyone ever told you that "the square root of two is: I wish I knew."

Please circle yes or no.

16. Do you know that the ratio of the opposite side of the acute angle of a right triangle, divided by the adjacent side is the same as the rise divided by the run?

Please circle yes or no.

17. If your answer is yes, please write when you learned this and who was the teacher.

18. Please circle another word that means the same thing as the rise divided by the run.

sine cosine tangent cotangent

19. In remembering the meaning of the values of the Roman Numerals from 50, 100, 500, 1000, designated by L,C,D & M, has anyone ever told you "Lucky Cows Drink Milk."

Please circle yes or no.

20. Have you ever heard a story described by the formula $[(X \times 2) + 8] / 2 - X = 4$

Please circle yes or no.

LEARNING THROUGH DIRECTED INSTRUCTION VS. COOPERATIVE LEARNING

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Introduction

As I begin my teaching career, I am overwhelmed by the contrasting information out there related to teaching techniques. Progressive pedagogy continues to push cooperative learning, while traditionalists see the value of a good lecture. Each of these teaching techniques has its advantages and disadvantages.

Cooperative learning is very hands-on and brings the real world to the classroom for students. However, it is time consuming to plan, can be disruptive and chaotic, and is not always effective. Sometimes, students might have fun and be doing things without actually learning. Lecture style is one of the oldest teaching techniques. When done well, it can be an outstanding way to present new information to students. The problem is doing it well. A boring, unorganized lecture can turn students off to a topic and does not inspire someone to want to learn.

As we move more and more into a time of educational accountability, teachers are searching for techniques that work. We continue to question how to present the needed information in the most efficient and meaningful way. What techniques will provide the greatest results from our students? Through my student teaching project, I plan to test both teaching methods with my sixth grade math classes.

Review of Literature

Students have worked in groups since the beginning of organized education. Group work has many different labels: cooperative learning, student team learning, group investigation, and collaborative learning. While each of these may differ in certain aspects of learning and instructional design, they all have attributes in common that apply to all group work. All group learning is based on a task designed on shared learning goals and outcomes (Slavin, 1996). Cooperative behavior involves building trust, joint planning, and understanding team support. Groups' sizes range from three to six people and individual accountability is expected. Outside of these few characteristics, cooperative learning can take on many different shapes and forms.

Cooperative learning can be very successful with adolescents. During this stage of development, students are more influenced by peer behavior and value independence from adult authority (Slavin, 1996). This age thrives on activity, independence, and socializing. Cooperative learning incorporates all these things while allowing students to help one another master an area of study.

There are different approaches to cooperative learning used with elementary, middle, and high school students. Each has had success and is more appropriate for some learning environments than others. Regardless of the method used, teachers must be flexible and willing to modify plans when working with small groups (Cohen, 1998).

Student Team Learning methods is one of the most widely used forms of cooperative learning. Its main focus is for students to set group goals and learn something as a team. Teams are rewarded for their success as a group, but individuals are still held accountable for their own knowledge. The team is rewarded based on the group's improvements, not a score comparison between groups. This allows for equal opportunities for success from high, average, and low achievers. Regardless of the level at which a student enters into the group, he can still contribute equally to the team's success (Slavin, 1996).

There are specific Student Team Learning methods that have been developed to work with adolescents: Student Teams-Achievement Divisions (STAD), Teams-Games-Tournament (TGT), Cooperative Integrated Reading and Composition (CIRC), and Jigsaw. With the first two methods, the class begins with the teacher presenting a lesson and then groups are divided and given tasks to complete. Groups are either quizzed or compete in tournaments to assess their understanding. CIRC is a technique for teaching reading. Groups work independently on assigned tasks while the teacher focuses on one small group for direct instruction. Groups rotate from task to task with each group having time with the teacher (Lindblad, 1994). Jigsaw and Jigsaw II are designed to let the students be the teachers. Both require students to become "experts" on one aspect of the lesson and then teach to the other group members. This is very effective in holding students accountable for general information about a topic. Peer pressure to teach one's topic helps keeps students engaged in the activity (Slavin, 1996).

Research has shown that cooperative learning can be very successful in the classroom. However, the effects vary considerably according to the method used. The teacher must set clear group goals and students must be held accountable for their individual work (Slavin, 1996). There should be group rewards based on the success and improvements of the team, but rewards should also be based on the success of each individual.

There are several concerns related to cooperative learning. Although it is vital that students learn to work together, many of life's activities are based on individual efforts. Taking tests and applying for a job are just two examples where students must be able to succeed on their own. If group work is all students are exposed to as a way to solve problems, they might have difficulty when left to problems on their own (Lindblad, 1994).

How students are grouped is an important element to the success of cooperative learning. Random selection and teacher assigned groups are the most prevalent. The most important thing is that groups are heterogeneous. Teachers should be prepared to deal with personality clashes between students. During adolescence, peers play the most important role in a student's life. Being forced to work with others that are not in one's social circle can initially cause problems. If students feel like an outsider in a group, they will often participate less and let others take over the group (Cohen, 1998). More popular, influential students can take over a group situation and dominate all aspects of the group dynamic. Teachers should take time to allow groups to get to know each other. Specific goals should be set for the group and individuals, and each student should have an assigned task. Teachers can emphasize a student's strengths by assigning tasks instead of letting students choose what job they would like. Students in cooperative learning classes seem to have higher self-esteem because they have been allowed to succeed in front of peers and contributed to the success of their team (Slavin, 1996).

It is a challenge to teachers to incorporate cooperative learning into the classroom successfully. Done poorly, group work can not only waste time, but also can damage student self-esteem, and provide inaccurate information about a topic to the students (Cohen, 1998). Just because students are active does not mean they are learning or constructing new knowledge (Clements, 1997). Teachers should consider several teaching techniques to help create a balanced classroom.

The word "lecture" used in elementary, middle, and high schools is often considered a bad word. Critics paint a picture of tired, bored students sitting in rows, facing a teacher that drones on forever about an irrelevant topic. In this picture, the teacher is usually oblivious to the attitudes and attention of the students as they write endless notes on the board and talk with no expression or enthusiasm in his voice. This might be a true representation in a few classrooms, but it is not the case when a lecture/directed instruction is done properly.

Directed instruction involves a teacher sharing ideas about a topic to her students. This one-way street of communication is necessary sometimes to provide explanations for new material or complicated concepts. "Lectures (explanations) are essential to students achieving, developing, and growing" (Ediger, 2001, p. 124).

Each day, teachers are expected to present more and more information to students, and students are held accountable for more and more knowledge. It can be very time consuming to use discovery methods or cooperative learning to address a topic. A good lecture can present a lot of necessary information in a shorter time span.

So, what is a good lecture? The instructor should constantly observe the student's attention span and be prepared to switch to a different activity or method of teaching if students are waning. Making eye contact with students helps keep them engaged in the lecture. Content should be meaningful to students. A teacher should practice using a variety of speech patterns to make listening easy. Appropriate stress, pitch, and juncture when communicating ideas can keep a student's attention longer (Ediger, 2001).

Critics might argue that students stop constructing new ideas and are passively absorbing or soaking up facts during a lecture. Constructivists believe that we are constructing knowledge even while listening (Clements, 1997). Students are working to make connections to previously learned material and create patterns with the new information presented. The key to making a lecture meaningful is tying it into previous knowledge. Teachers must make connections to things the students have already learned.

Cooperative learning and lectures can be successful instructional methods. The key to positive achievement for most students is to have a variety of opportunities to learn. Teachers must learn to use an assortment of teaching techniques in order to successfully meet the needs of all students.

Cooperative learning should not be used to just liven up the classroom from time to time. It should be used to complement lectures, discussion, and discovery learning.

Specific goals for both groups and individuals should be established from the beginning (Lindblad, 1994). Special considerations should be made to help all levels of learners be successful (Cohen, 1998). When using the lecture format/directed instruction, teachers should connect the lesson to prior knowledge and to relevant topics in the students' lives.

Regardless of the instructional method used, teachers should set specific goals for students that involve a variety of ways to assess their success. Life will present many different types of problems to students. They should be equipped with tools and strategies to address these many situations (Ediger, 2001). A teacher's success depends on being flexible and providing students with a variety of learning opportunities. Learning in different ways can help prepare students for future challenges.

Data Collection and Results

Two sixth grade classrooms of equal academic levels were selected to be a part of this study. Each class was presented a unit on the basics of geometry. All of the content for both classes was the same. However, for the first group, the class was taught with the lecture format. The second group was presented the same material with much of the time being devoted to cooperative learning. Each group was given a pre-test (see Appendix A) and post-test (see Appendix B) to assess knowledge gained. The improvements for the groups were then analyzed and compared to see which teaching technique was more successful.

Group 1 was taught primarily using a lecture format and improved, as a class, 107% between the pre-test and post-test. The students' scores ranged from 17 to 70 on the pre-test and 42 to 110 on the post-test. Overall, the class made great improvements after the unit was taught with the class average going from 41 to 85. Figure 1 shows each student's scores.

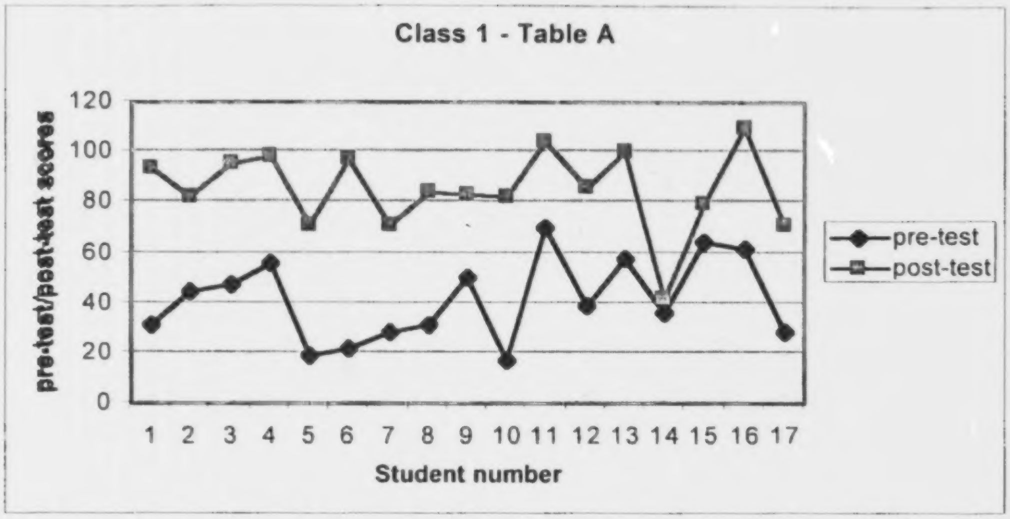

Figure 1. Pre-test/post-test results for the lecture-format group.

Group 2 was taught using a variety of cooperative learning techniques including, STAD and Jigsaw. Lessons were more hands-on and students had more opportunities to be active and interact with each other. The students' scores ranged from 11 to 50 on the pre-test and 33 to 95 on the post-test. The class improved 158% between the pre-test and post-test. Even though the overall scores were lower, the improvements were greater. The class average before the unit was 32 and after the unit was 80. Figure 2 shows each student's scores.

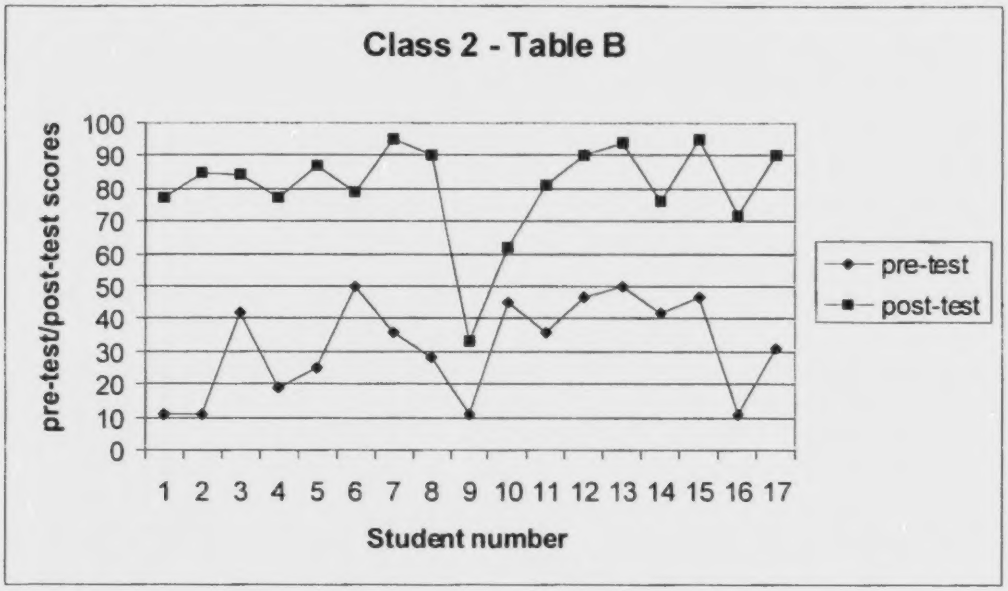

Figure 2. Pre-test/post-test results for the cooperative-format group.

Overall, most students had a dramatic increase in knowledge of the material taught. However, Group 2's increase was greater than that of Group 1. Figure 3 shows each class' percent increase from the pre-test to the post-test.

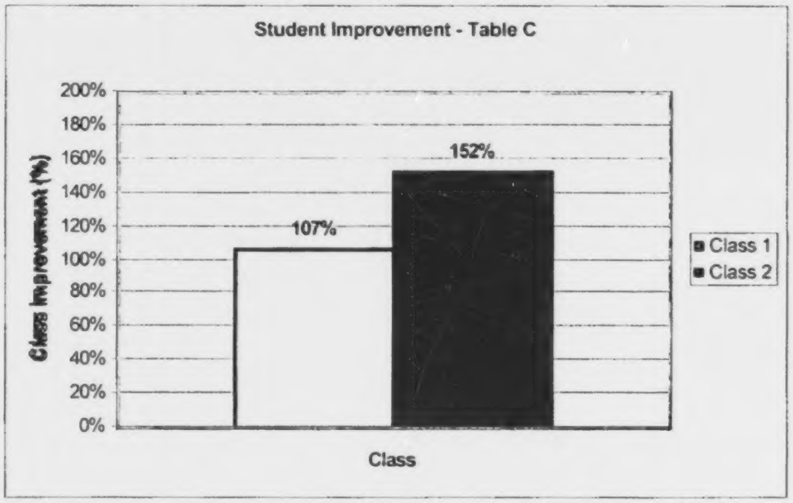

Figure 3. Student improvement by class.

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Conclusions and Recommendations

Based on the results of this study, I believe that students will be more interested in lessons that incorporate cooperative learning. They are more engaged in learning and therefore have a better grasp of the materials. The students from Group 1 that were taught with a lecture format had increases in their test scores, but overall, Group 2 did better. In order to make this study more accurate, the different types of instruction would need to be carried out over a longer period of time. Though limited by only a 2-week study, it is possible that some students would perform just as well in the long run, regardless of the instructional techniques. Student performance could have also been affected by the fact that a new teacher was coming in and changing the continuity of their class. Overall, no clear conclusions can be made because of the outside variables that could not be controlled.

Most research agrees that teaching with a variety of techniques is the most effective way to reach all students. Differentiated instruction allows students to approach a topic in many different ways and see things more holistically. I recommend that teachers continue to pursue professional development opportunities that strengthen their delivery of information through both lecture and cooperative learning. Regardless of the methods teachers use, incorporating technology into the classroom can enrich a lesson. PowerPoint presentations and the use of light boxes with the Internet can bring new life a traditional lecture. There are endless possibilities for including technology into cooperative learning. The key is to let technology be a tool for students and not become the sole focus.

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Appendix A

Shapes and Designs Test

Name ________________________________ **Date** _____________ **Block** ________

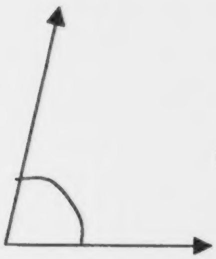
Fill in the blank using the words from the list below.

polygon	vertex	quadrilateral	angle
degree	equilateral triangle	right angle	perpendicular lines

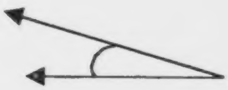
1. _________________________ An angle that measures 90°.
2. __________________________ The corners of a polygon.
3. __________________________ A closed, flat (two-dimensional) shape whose sides are formed by line segments. Examples include a hexagon and pentagon.
4. ________________________ A polygon with four sides.
5. _________________________A unit of measure of angles equal to 1/360 of complete circle.
6. _________________________ Lines that intersect to form a right angle.
7. _________________________A triangle with all three sides the same length.
8. ________________________ The opening between two straight lines that meet at a vertex, measured in degrees or radians.

Measure the following angles using the angle ruler. Label each as acute, obtuse, right or reflex

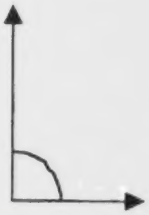
9.



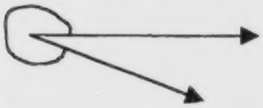
10.



11.



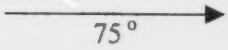
12.



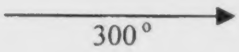
Using the angle ruler, draw angles with the given measure.

13.

14.



15.



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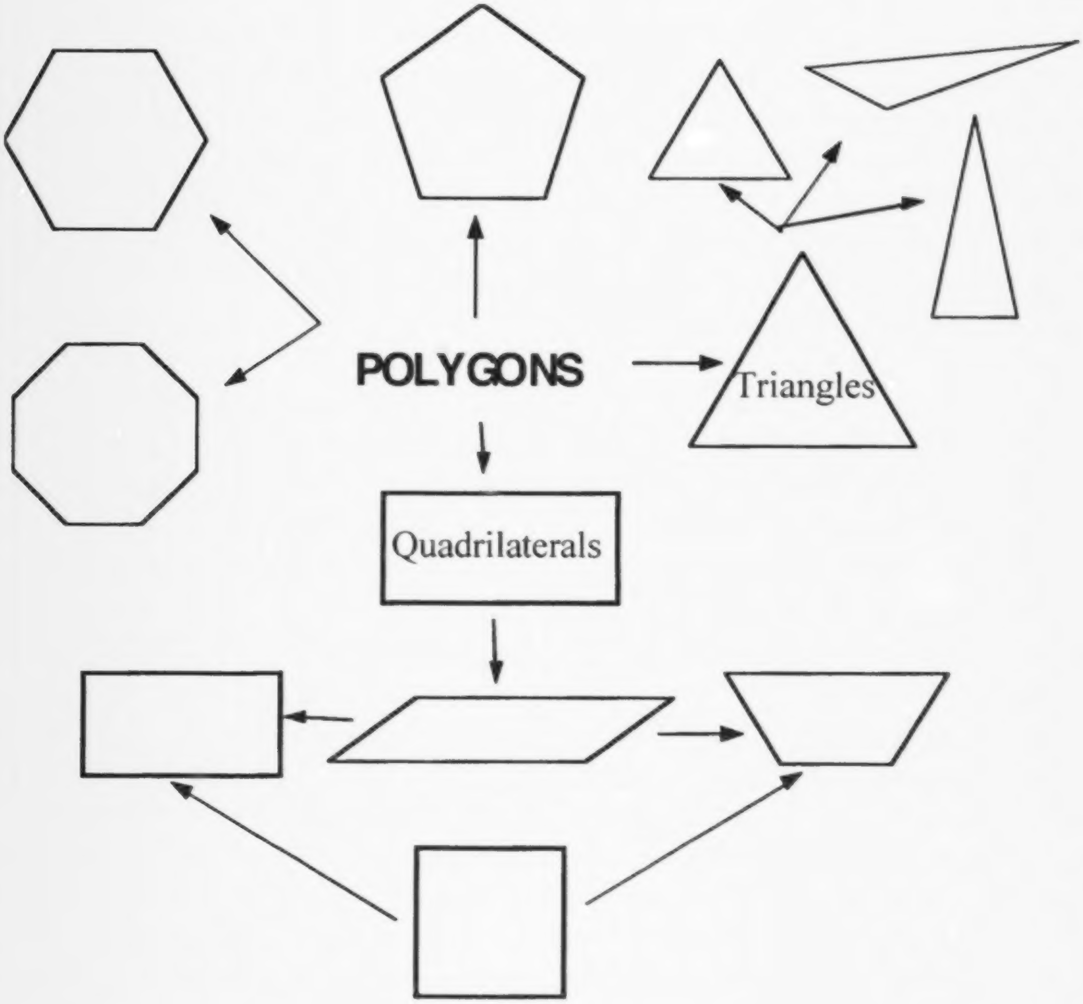
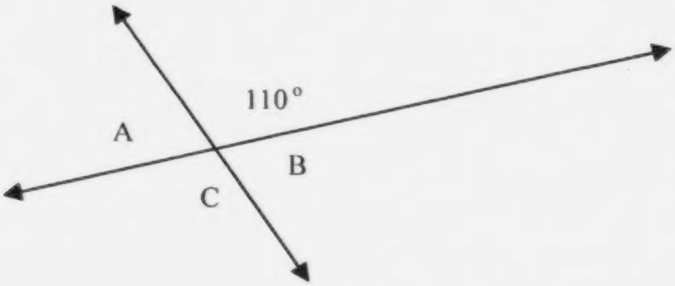
16–26 Label the following diagram. naming each polygon using the list below

isosceles triangle
octagon
square
parallelogram
equilateral triangle
scalene triangle
rectangle
trapezoid
hexagon
pentagon


POLYGONS
Triangles
Quadrilaterals

Label the measurements for the following angles



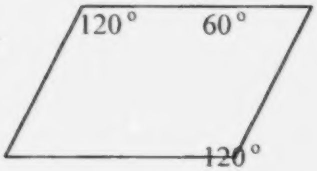
30. A - ________

31. B - ________

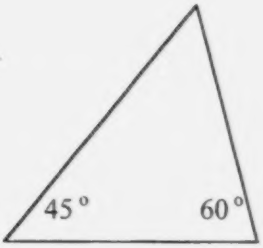
32. C - ________

Find each missing angle.

33. _______

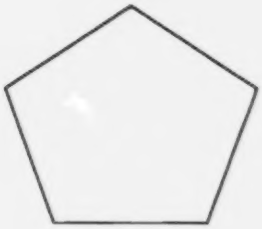


34. _________

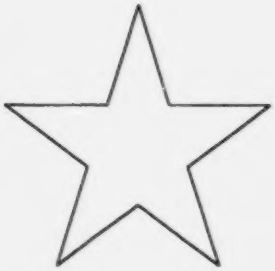


Draw 3 lines of symmetry through the shapes below.

35.



36.



Appendix B

Shapes and Designs Post-Test

Name ______________________________ **Date** ____________ **Block** ________

Fill in the blank using the words from the list below.

polygon
degree
parallel lines
vertex
equilateral triangle
acute angle
quadrilateral
right angle
obtuse angle
angle
perpendicular
straight angle

9.

10. ________________________ An angle that measures 90°.

11. ________________________ The corners of a polygon.

12. ________________________ Lines that never intersect.

13. ________________________ A closed, flat (two-dimensional) shape whose sides are formed by line segments. Examples include a hexagon and pentagon.

14. ________________________ A polygon with four sides.

15. ________________________ An angle that measures less than 90°.

16. ________________________A unit of measure of angles equal to 1/360 of complete circle.

17. ________________________ Lines that intersect to form a right angle.

18. ________________________ An angle that measures between 90° and 180°.

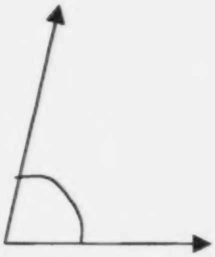
19. ________________________A triangle with all three sides the same length.

20. ________________________ The opening between two straight lines that meet at a vertex, measured in degrees or radians.

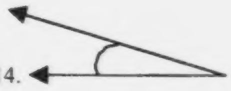
21. ________________________ An angle that measures 180°.

Measure the angles using the angle ruler. Label each as acute, obtuse, right or reflex

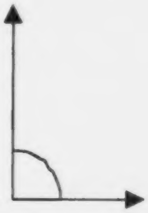
13.



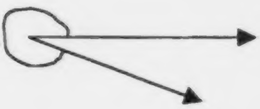
14.



15.



16.



Angle: ________ ________ ________ ________

Type of angle: ________ ________ ________ ________

Using the angle ruler, draw angles with the given measure.

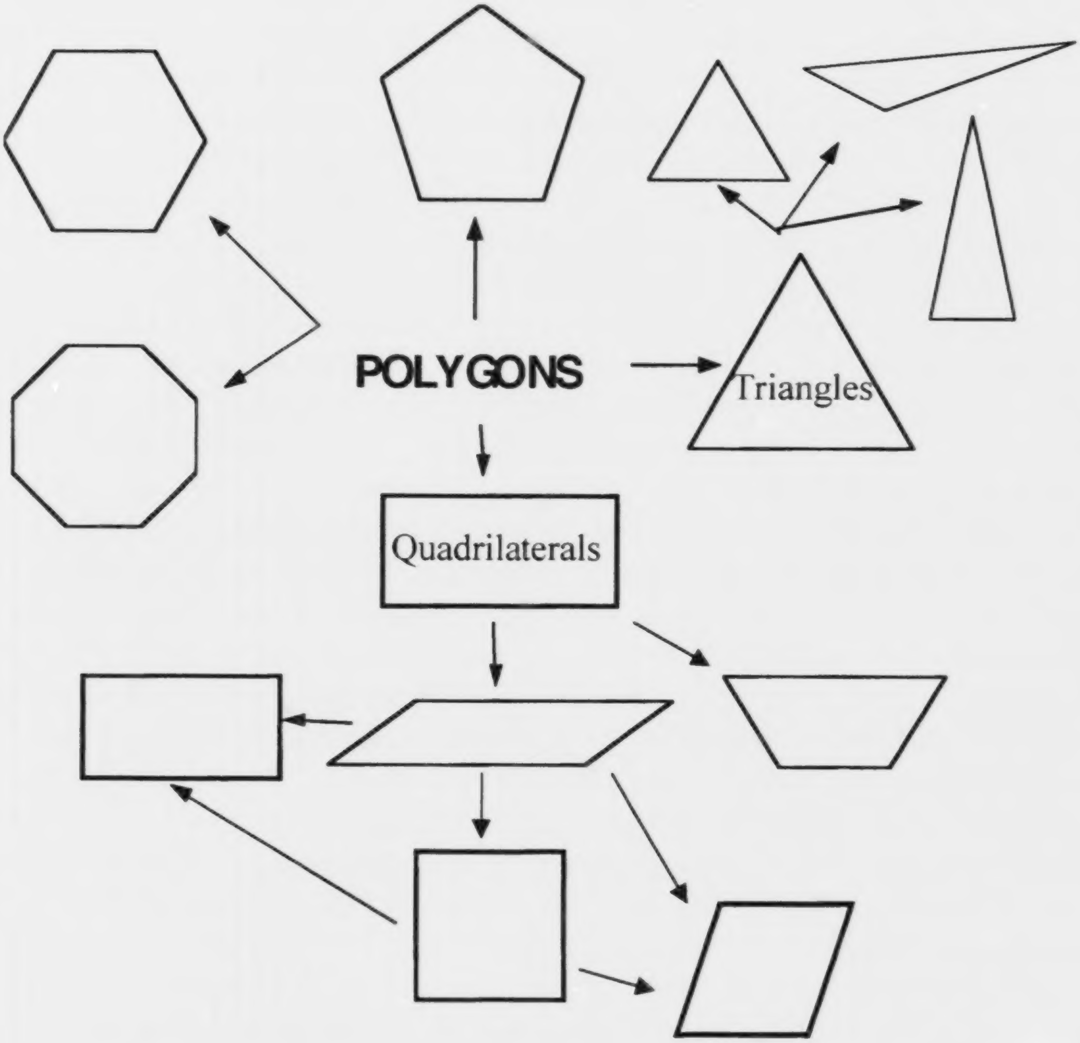
18. 160°

19. 75°

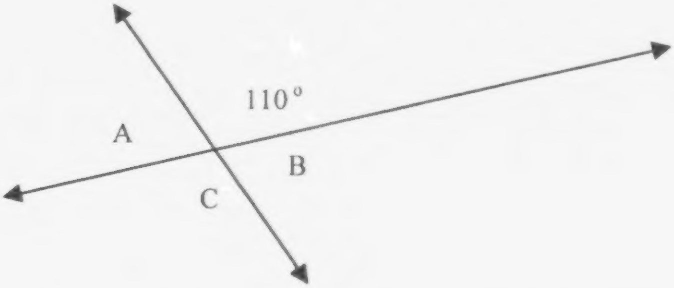
20. 300°

21-31 Label the following diagram, naming each polygon using the list below

isosceles triangle
octagon
square
parallelogram
equilateral triangle
scalene triangle
rectangle
trapezoid
rhombus
hexagon
pentagon


POLYGONS
Triangles
Quadrilaterals

Label the measurements for the following angles –
DO NOT USE YOUR ANGLE RULER!!!! CALCULATE THE PROBLEM INSTEAD!



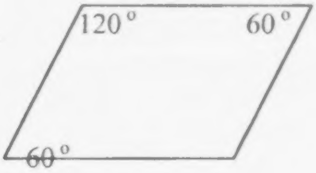
32. A - ________

33. B - ________

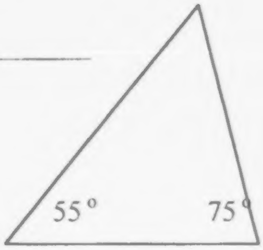
34. C - ________

Find each missing angle. DO NOT USE YOUR ANGLE RULER!!!!
CALCULATE THE PROBLEM INSTEAD!

35. ______

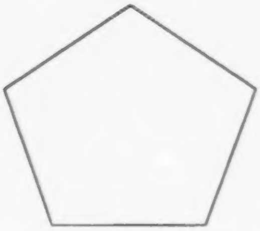


36. _________

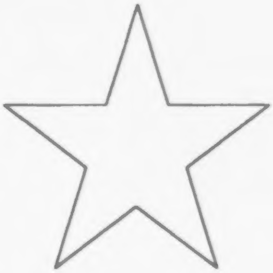


Draw 3 lines of symmetry through the shapes below.

37.



38



39. Carolyn made a triangular painting and measured its sides. The numbers she wrote down were 35 cm, 55 cm, and 95 cm. She said, "That can't be right. I must have made a mistake." How did she know?

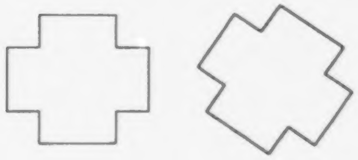
Label the following triangles as isosceles, scalene, or equilateral.

40. a triangle with the sides 3, 3, 5 ____________________

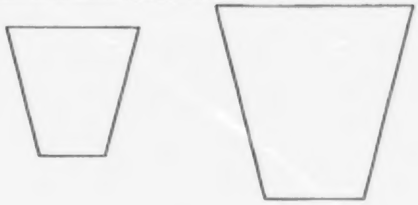
41. a triangle with the sides 5, 5, 5 ____________________

Label the following as congruent, similar or neither

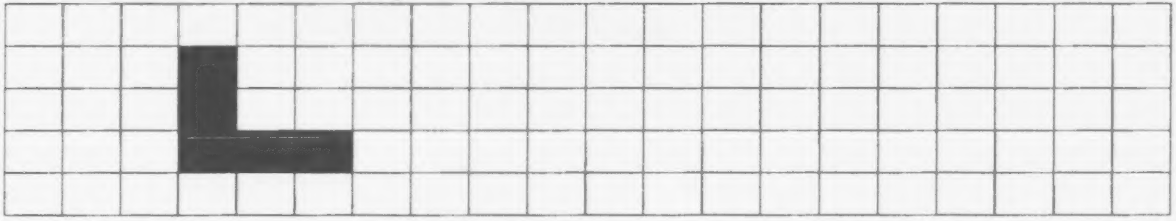
42. ______________________



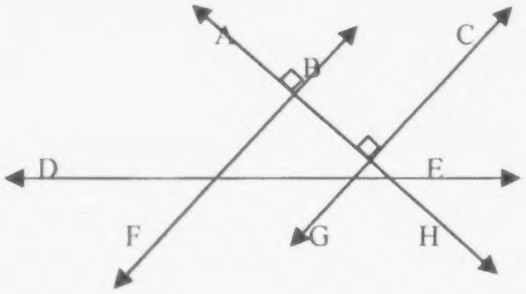
43. ______________________



44. *Draw a translation of the shape below*



Use the figure to your right to name each of the following



45. Two lines that appear parallel

46. Two intersecting lines

47. A line that is perpendicular to two lines

48. A line that intersects three other lines

EFFECTS OF EMPHASIZING THE PROCESSES OF SCIENTIFIC INQUIRY IN RELATION TO STUDENT MOTIVATION AND ACHIEVEMENT IN THE MIDDLE SCHOOL SCIENCE CURRICULUM

John Ramey

The University of Tennessee at Chattanooga

Introduction

Emphasizing the processes involved in scientific discovery is the current focus of prescribed best practice in the methodology of science education. This approach to teaching science urges the teacher to back away from holding a central position in the classroom and rather to assume the role of facilitator as students explore science directed by their own natural curiosity. The literature documenting research into this method of science instruction is alluring. Much of this literature paints an attractive picture of classroom communities of young scientists actively engaged in research and discovery. Students learn the way that science is done and they learn how to become a part of that process. This vision arouses my curiosity because I never experienced a classroom environment like this during my years as a science student. My experience in the science classroom, as well as that of many students at all levels of science education, has emphasized the more traditional approach: learning the facts, theories, and laws of the various science disciplines. The past dominance of the traditional approach to science instruction has achieved some impressive results. Astronauts have walked on the moon, many tragic diseases have been eradicated, and technology has fundamentally changed the ways people live. These achievements are directly related to work performed by a long line of scientists that often found a foundation for discovery in their knowledge of factual scientific content.

I would like to know what teaching method I can use that will result in the highest possible achievement and motivation levels for my middle school science students. Though I learned science through a more traditional approach than is now advocated by curriculum standards, I have developed a genuine fascination for it. I'm not sure if it was the methods through which I learned science, or simply a natural predisposition towards science, that has influenced my enthusiasm for the subject. I'm interested in discovering whether using an inquiry approach in my classroom will increase my students' motivation and achievement in science. I expect that an increase in motivation to learn will be accompanied by an increase in achievement. Songer (2002) reported that while many students hold favorable attitudes towards science careers, a much smaller proportion hold these same positive attitudes towards classroom science. This could imply that instructional methodologies used in the science classroom could play a role in steering potentially effective scientists away from careers in science. I want to use a method of instruction that will reduce this disparity between students' attitudes towards careers in science and attitudes towards classroom science.

I am interested in finding evidence of a relationship between using a teaching method that emphasizes the processes of doing science through inquiry, as suggested by the National Science Education Standards (National Research Council, 1995), and motivational and achievement levels of students. I would like to compare any observed changes in motivation and achievement levels among students learning science as taught by these methods to the changes in motivation and achievement observed among students learning science through a more traditional approach. Though the National Science Education Standards maintain that inquiry is the most effective approach to teaching science, research is still inconclusive on this point (Chang & Mao, 1999; Von Secker & Lissitz, 1999). The purpose of this study is to test the following hypothesis: implementing a teaching strategy which emphasizes the processes of scientific inquiry, as suggested in the National Science Education Standards, among middle school students in the Hamilton County public school system will increase these students' achievement in their science classes.

Review of Literature

Reform movements in science education call for teachers to emphasize the processes involved in *doing* science as they teach the content of the curriculum. One of the leading documents of this reform movement is the National Science Education Standards, a product of the National Research Council. According to the Standards, "Inquiry into authentic questions generated from student experiences is the central strategy for teaching science." (National Research Council, 1995, p. 31). An essential aspect of using this strategy for science instruction is the requirement that much more class time be spent facilitating students' abilities to use the processes of science as a source of learning about the natural world. Teachers should cover less factual content and explore more deeply the themes they do choose to teach by using inquiry as the vehicle of exploration.

The proper methods and proportions of using inquiry in the curriculum, and the resulting effectiveness of these methods has been a source of much debate. Many teachers have never learned science according to the methods suggested by the new standards. The learning experiences of most teachers, including pre-service teachers, has been one of learning the established facts, theories, and laws of science. Given that most teachers are inclined to teach as they were taught (Costenson, 1986), many question the effectiveness of the new emphasis on inquiry in the Standards.

Roth (1993) suggests four levels of using inquiry in science lessons. The lower levels of his four-point scale involve using activities that give students a problem to investigate and then take the student through an explicit set of steps to reach the conclusion. These activities are usually basic verification procedures of established scientific phenomena. The higher levels of the scale involve either activities where a problem is given but no procedures are offered to guide students toward discoveries, or activities where even problems are not stated. Students are confronted with raw phenomena and left to develop their own inquiries. The type of inquiry advocated by the Standards is that most resembling the higher levels of Roth's scale. The author notes that inquiry at these higher levels shows strong correlations with Piaget's formal operational level of cognitive development, and further notes that a majority of middle and secondary students do not reason at this level. In a study focusing on middle school students' abilities to reason about scientific data, Vellom and Anderson (1999) saw little evidence that students were able to generalize processes used in a particular inquiry activity to other activities. Yet, they suggest that inquiry activities can form the basis for students' future understanding and appreciation of scientific constructs. Costenson (1986) also addresses this concern for implementing an emphasis on inquiry into the curriculum, citing a lack of formal operational students as a reason that many teachers resist using inquiry methods. Appeal is made to the fact that many early elementary teachers are able to successfully implement rudimentary inquiry activities into their science lessons. Thus, middle and secondary teachers should also be capable of using inquiry successfully with varying levels of student coaching.

The National Science Education Standards stress the importance of making the science curriculum accessible to all students. Inquiry, founded on issues that are relevant to students' everyday lives, is assumed to be the best method for making the curriculum accessible to all students. Many researchers have explored this assumption. The focus of this area of research is to assess whether standards-based teaching improves science achievement equally among the diverse populations in American schools. In a study of the effects of using an inquiry approach with urban African-American middle school students, Kahle (2000) concludes that standards-based teaching does make a difference with this segment of the population. Another study, targeting urban classrooms, stresses the important role of technology for effective inquiry in the science classroom. This study urges the National Research Council to explicitly address the need for all students to have equal access to the extra time and materials required for inquiry. Current inequity among schools creates a situation that limits the implementation of good inquiry curricula in many urban schools. This study found that using technology as a resource for inquiry activities, while effective, was not able to completely overcome classroom barriers common to these schools such as class size, space, and reduced instructional freedom (Songer, 2002). Further research has explored the effects of using inquiry for science instruction with LD students. It has been found that these students are more motivated to learn and they achieve higher in comparison to LD students learning science in a curriculum that emphasizes a more traditional approach. It is noted, however, that LD students may require more coaching than other students.

Contrary to the above findings, in a meta-analysis of data collected during the 1990 High School Effectiveness Study, Von Secker (1999) found evidence that Standards-based instruction may be associated with contributing to greater achievement gaps among diverse populations of learners. This study focused on three major components of the Standards: providing more time for laboratory inquiry, increasing emphasis on critical thinking, and reducing the amount of teacher-centered instruction. The latter two of these aspects of the Standards were found to be associated with lower achievement among some groups of students, whereas increasing time for laboratory instruction was found to raise achievement levels for all students. In her conclusion, Von Secker states that,

> "The consequences of changing the way students are taught are not self-evident. By 1990, teachers reported that they were using student-centered strategies that were recommended in the Standards 6 years later, with mixed results. Despite strong theoretical grounding, support for a Standards-based science program is still largely anecdotal. It seems reasonable to us that assessment of the effectiveness of instructional practices promoted by the authors of the Standards, however well informed conceptually, should be evaluated using the same rigorous evidentiary criteria that they recommend students apply to scientific inquiry in the classroom" (1999, p. 122).

In another study comparing the effectiveness of inquiry versus traditional instruction, Chang (1999) also finds this discrepancy in the literature.

Given the fact that the Standards avoid stating explicit steps to follow during the process of scientific inquiry, it may be helpful to briefly review how some influential commentators have described the key elements involved in scientific discovery. In addition, further understanding of what an effective inquiry curriculum might look like might be revealed by briefly reviewing model curricula that have been developed. Franz (1990), a scientist with 34 years of distinguished research experience, argues that scientists rarely follow a prescribed list of procedures as they do their work. On a list of 10 important aspects of scientific research, chance, imagination, intuition, serendipity, and overcoming difficulties, are some that are overlooked by what is commonly stated to be the official scientific method. Franz qualifies the place of chance in scientific discovery by quoting Pasteur, who said that, "chance favors only the prepared mind." Having a good base of factual, scientific knowledge is clearly an important aspect of what is here considered to be the prepared mind. Yet Franz offers an image of science that is not dogmatic, but rather a creative and imaginative side of scientific discovery is revealed. This is an important aspect of science that the Standards wish to portray in the science curriculum.

How have some teachers attempted to implement a strong foundation of authentic and relevant scientific processes into their teaching methods? And have these methods proven to be effective in raising student achievement? In a case study of an inquiry lesson in one middle school class, Vellom (1999) closely documented the development of events as students explored different possibilities for stacking three liquids with varying densities. The students did not know that density was a factor. Over the course of several days students experimented with possible stacks. When they presented their findings there were discrepancies among the results reported by the groups of students. The instructor never suggested that any of the students' findings were right or wrong; he left it to them (though he facilitated the process) to figure out methods for verifying which stacks were correct. Over the course of several more days, students came to rely more heavily on empirical evidence for verifying their claims. The goal was for them to come to mutual agreement about which stacks were possible. This activity spanned 12 class days. During this period, students, in large part, followed procedures used by real scientists working within a broader scientific community. No correct answers were given to the students; their job was to seek answers in the same way that practicing scientists must as they proceed with their research into what is unknown. This was an impressive and well-executed activity, but the problem remains as to whether this was the most effective way to boost students' achievement in science.

The methods for teaching science suggested by the National Science Education Standards are very inviting. Science is portrayed as an active process of exploration. It seems that by portraying science in this way, the Standards come closer to the nature of science than do standards advocating a more traditional approach to the curriculum. Yet, it also seems that a strong foundation in the 'facts' of science may be an essential ingredient of what it is to be an effective scientist. As Pasteur said, "chance [in scientific discovery] favors only the *prepared* mind." The reality we face as teachers is that time is limited. We need to search for a way of teaching that will be the most effective in the limited amount of time we have to teach what has the potential to be a vast amount of material. There are a lot of 'facts' that could be learned in a science curriculum, and presenting science as a body of facts removes students from the nature of science as an ongoing process. The best methods for teaching science are still unclear. The literature tends to support the methods advocated by the Standards, but there are studies that have reached alternative conclusions. The literature surrounding the use of inquiry, as a method of teaching in which *doing* science is emphasized, invites more research if it is to be clearly established as the best method of science instruction.

Data Collection and Results

Data for this study was collected during a 2-week unit on electricity and magnetism in an 8th grade physical science course. The students that participated in this study attend an urban, inner city, magnet school. The school is a new facility that is very well equipped with materials for student inquiry into the content of this unit. The scheduling in the school was optimal for this study. Students attend science every other day. There are six blocks of science classes. Three blocks come to science class each day on an alternating A/B schedule. The three blocks attending science on 'A' day were used as the treatment group for the study. The three blocks attending science on 'B' day comprised of the control group. There was a total of approximately 150 students that participated in the study. Both the treatment and control groups contained about 75 students each. Several weeks before data collection was to begin, the students were given assent forms. These forms explained the purpose and procedures of the study. Students were asked to sign the form if they were willing to allow their scores to be used for research purposes. Students were given similar forms to bring home to their parents or guardians for a signature of consent.

The day before beginning the unit on electricity and magnetism, all students were required to complete a short test containing 11 questions designed to assess their prior knowledge of the content to be covered during the unit (See appendix A). Shortly after the completion of the unit, all students took an identical test (See appendix B). These pre-test and post-test assessments were used as an instrument for comparing the effectiveness of two teaching strategies.

Students in the treatment group were given instruction that emphasized scientific inquiry and discovery. The processes involved in *doing* science were the focus. Students in the control group were given instruction that did not have this emphasis. Learning *about* science was the focus of instruction in these classes. Students in the two groups did all of the same activities, and the same curricular content was covered for each group of classes. In the treatment group, a strong effort was made to encourage students to develop and discuss their own explanations of phenomena they observed in hands-on activities. These activities were done before the related factual content was covered with the classes. Students were confronted with a particular phenomenon, and asked to make and record observations, take data, and attempt to develop explanations. As an example, one topic to be covered with the students was electromagnetism. The students were given iron nails, different lengths of wire, a battery, a battery holder, and washers. Students were asked to make the iron nail into a magnet with these materials. By wrapping the nail with wire and supplying an electric current, an electromagnet can be created. The more wire, and/or the more voltage used, the stronger the electromagnet will be.

The control group of students didn't have the same opportunity for discovery and the development of their own ideas and theories. For this group of students, the factual content related to a hands-on activity was covered first. After students were introduced to the facts, were they given materials to work with as verification and reinforcement. The same electromagnet activity was used as verification of previously covered content rather than as an opportunity to explore and make discoveries. In this way, both groups did the same activities but they served different purposes. The amount of factual content that was covered did vary some between the control and treatment classes. The treatment group often had less time to devote to covering the factual content than did the control group. The hands-on inquiry process was more time consuming than the hands-on verification/reinforcement activities.

When the unit was completed and student learning had been assessed with the pre-test/post-test instruments, it was time to compare the numbers to find out if there were significant differences in learning between the two groups. Figures 1 and 2 show each class' average on the pre-test and post-test. Blocks 1, 2, and 3 were the treatment classes. Blocks 4, 5, and 6 were the control classes.

Block	Pre-Test Average	Post-Test Average
1	58	65
2	36	52
3	36	50
4	35	47
5	36	45
6	35	54

Figure 1. Pre-test and post-test averages.

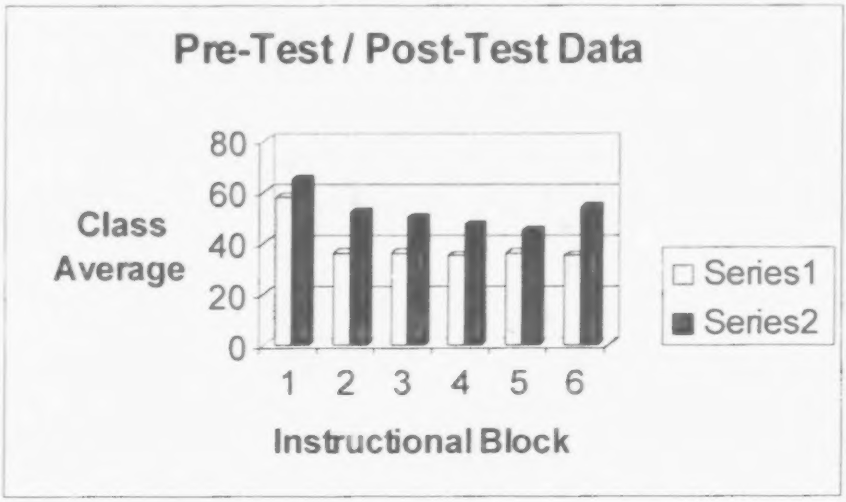


Figure 2. Pre-test and post-test averages.

As the data indicate, all classes showed minimal improvement between the pre-test and post-test assessments. The results were disappointing. The average number of percentage points gained on the post-test was 12.8 points. The largest improvement was seen in the sixth block. This class gained an average of 19 points. The lowest level of improvement was the first block. This class gained an average of only 8 percentage points. Sixth block was one of the control classes and first block was one of the treatment classes. The average improvement, in percentage points gained, in the control classes was 13.3 points. The average improvement in the treatment classes was 12.3 points. The control group students, based on these averages, scored one percentage point higher on the post-test than the treatment group students. The minimal difference in improvement seen between the two groups did not warrant the application of statistical tests of significance (see conclusions).

Conclusions and Recommendations

As measured by the pre-test/post-test assessments, student learning during the electricity unit was minimal. Though data collection for this unit covered 2 school weeks, the unit was only 5 days long. Classes met only every other day for physical science. It is probable that an attempt was made to cover too much material in a short period of time. During this 5-day unit, two full-day laboratory investigations were also conducted. The pre- and post-test assessments had more of a fact rather than concept orientation. A difficulty that was encountered in this study was that comparing student learning between classes that emphasize the scientific process over the content (*doing* science), to classes that emphasize content over process (learning *about* science) is a bit like comparing apples to oranges. The emphasis is different in the two methods, so the means of measuring student learning should also be different.

The largest difficulty with implementing this study was the investigator's lack of experience with teaching, and possibly the students' lack of experience with learning science through inquiry. More time was spent with classroom management than was expected. It seems that this study would require more time for reliable results to be attained. Students needed more time than five lessons to become accustomed to exploring natural phenomenon through scientific inquiry. It also takes time for students to become accustomed to the styles of different teachers. Students in this particular case were accustomed to a very different classroom environment than was provided during the course of the electricity and magnetism unit. Another factor that may have influenced the poor improvement levels between the pre- and post-test assessments was the fact that 1 week of state testing followed by spring break occurred in the midst of the unit.

Given the challenges of inexperience with teaching and classroom management in an inner city middle school environment, limited time, students unaccustomed to learning science through inquiry, and having testing and spring break occur during the midst of the electricity unit, I feel uncomfortable with any attempt to draw conclusions based on this study.

One qualitative observation was that students became very engaged during the discovery activities. I feel that an interest in electrical and magnetic phenomena was evident in many of the students. I felt that the treatment classes became more engaged with the labs. They became engaged in trying to develop explanations of their observations. The treatment classes were also given more time to experiment and work with the materials. Since their investigations had much less guidance, they took longer.

The control groups were guided through the labs as a verification/reinforcement exercise. In this situation the labs did not take as long.

In conclusion, I would again say that I feel that, for this study to produce reliable results, it would require a more experienced teacher and classroom manager, as well as more experience with the classes of students, to be involved with the study. The time frame of the study may have also been a barrier.

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THE MERITS OF GEOGRAPHY TEACHING THAT ENGAGES AND PROVIDES EXPERIENTIAL LEARNING FOR STUDENTS

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Introduction

The basic point of my study was to determine, through a written survey, whether having students take part in learning projects that are personally involving or engaging adds to their learning of geography and encourages more interest in geography. The problem being studied came about after hearing in my education classes at The University of Tennessee at Chattanooga that secondary school teachers often just go through a social studies textbook without offering intriguing lessons and that the students often find social studies boring. Although I have taken some boring history and geography classes, I have been interested in the two subjects since taking some engaging social studies classes in elementary school.

Another reason for this study was that I had read in an article last fall in one of my classes that getting students personally involved or engaged adds to their understanding and enjoyment of social studies.

During my student teaching placement, working with mostly 9th-grade world geography students at the high school level in January and February 2003, I tried to engage the students. I would almost, on a daily basis, distribute to the students a handout of what I thought were interesting facts about a country. Much of the information came from Internet sites, and a strong emphasis was placed on the human aspect of geography. At the end of each fact sheet, I would usually ask the students to respond in writing to about two questions that asked their opinion on a topic. I would then go around and get students' verbal responses to the questions.

For example, we looked at a handout about how people in Italy are different from Americans, and then I asked the students to write what they would like and dislike about living there. Another time, we looked at bullet trains in Europe, and I asked the students, in pairs, to imagine that the United States had an extensive bullet train system and for them to list three or four places they would like to go in a day.

The projects were all designed to get the students personally involved and engaged in learning geography.

This topic was selected, primarily, because I want to be the kind of teacher that makes learning geography fun and meaningful, and I wanted to see if these exercises did make learning fun. I also wanted to test validity of what some of my education professors at UTC had told me: that teaching and learning should be engaging.

Based on the amount of discussion in some of my classes, I would say that the topic is a local, state, and national issue. But I do not believe it is a staple of the curriculum in my field. My cooperating teacher used the more traditional teaching methods of lecturing and having the students answer questions in the textbooks. However, she did offer such out-of-class enrichment projects as having the students make flags and timelines about countries they had selected.

Literature Review

Of the six reviewed articles related to the topic, all say that personal geography projects engage the students more than a typical lecture or textbook reading project would.

One article (Morgan, 2001) talks about a seventh-grade social studies class at a New Jersey middle school drawing and painting a map of the world in the parking lot of their school. The teacher, Chris LoNigro, said the project was done to impress upon the students the United States' location in relation to the rest of the world's countries. The teacher felt the project worked and was engaging. As evidence, he said that the students spent time after school and during lunch breaks painting the countries. The instructor added that he was even able to get his three daughters from other classes and schools involved.

Another article (U.S. Department of Education, 1996) points out some statistics that shed favorable light on engaging projects. The article primarily points out the geographic knowledge and skills of students in grades, 4, 8, and 12, but it does say that students in grades 4 and 8 who reported using maps and globes once or twice a week outperformed those who reported never using them. Also, students who reported doing projects related to geography had higher average scores than those who reported never doing them. The article also says that a positive relationship seems to exist between performance and use of films, videos, and filmstrips in the classroom.

An article (Torjman, Clipsham, Hamiton, & Yan, 2002) related to a ninth-grade physical geography class in Ontario, Canada, points out the positive benefits of a project in which the students conduct statistical research on a demographic theme of their choosing. It said the students produce statistical graphs for a board display and then give oral presentations on the material. The article said that the project has been quite successful in engaging students to examine critically the current Canadian population issues and to help predict future trends. One group of gifted students liked the resource-based learning approach so much that they asked if they could do the same type of project for learning about Canadian agriculture.

The teachers found that the students participated more in the discussion when the information was presented by their peers. Also, the instructors found that the students became motivated by the assignments when they selected the topic.

An article (Marcello, 2002) on standards-based geography instruction points out that engaging students in inquiring into geography and geographic questions promotes a positive, constructive approach to teaching, one in which the geography teacher is the facilitator. This enables the students to construct, examine, and extend meaning to geography topics. Geographically-informed students should also be able to ask and answer questions several ways and provide opportunities for students to do it, the article says, and helping them achieve this is the role of the facilitative teacher.

The article (Heinz, 2000) that motivated me to pursue this project and style of teaching was one written by Elgin Heinz which was read in Dr. Lucien Ellington's Educ 452 class. In the article, Heinz makes recommendations for using creative methods for teaching about other cultures.

The writer, who spent some of his early years in China, begins by recalling how a creative idea helped him when he was assigned to teach world geography in an emergency situation as a young teacher. The students were non-readers, so the previous teacher had left him some videos about other countries. He said the discussions among the students after the films were viewed provided for interesting and rich learning.

However, he also learned that a slide was better than a video for viewing and learning. He also said that using two slide projectors was better because one could make some comparisons. And to prevent polarization from taking place, he discovered that using three projectors was even better. He learned that three-way comparisons were better in any classroom situation.

He said he was frustrated as a young teacher by students who were unenthusiastic from years of being force-fed facts from teachers who wanted students only to make good grades, and from administrators interested only in non-controversial teaching. However, he did have the support of some parents, who remembered that their students were still discussing what went on in his class over dinner.

He adds that he was later encouraged by such outreach organizations as the Stanford Program on International and Cross-Cultural Education, which encourages teachers to get students involved in their own learning through outreach methods and materials. An example might be to skip getting a docent to give a tour at an art museum, but having the students examine five or six items on their own and then getting together with the teacher and docent later for discussion.

Heinz also said that an effective way of teaching reading is by getting the students personally involved and by having them look for people with whom they can identify in a story.

Another article (Leming, 1998) points out, however, that getting high school students to think critically has been both a cherished and elusive goal of social studies educators, and he believes students' mental development levels may explain what he sees as limited success.

Data Collection and Results

At the end of my approximately 7-week placement, the students were given a survey sheet and asked to respond anonymously and in writing to four questions. The first was whether the enrichment classroom exercises that personally involved them were enjoyable or meaningful. The second question asked them to answer why they enjoyed or did not enjoy the exercises. The third question dealt with whether and how the exercises added to their understanding of the topic. The fourth question asked them to list other enrichment projects they might enjoy doing and ones that might also help their understanding of a geography topic.

In total, 73 out of the 81 people said that they found the engaging exercises I did enjoyable or meaningful. Out of the 19 class members in the first-period class who responded to the first question regarding whether or not the classroom exercises that personally involved them were enjoyable or meaningful, 17 responded that they were. In the third-period class, 15 out of the 16 students wrote that they enjoyed the exercises. In the fourth-period academic honors class, 17 out of 18 said they enjoyed the exercises. The other one said the exercises were "somewhat" enjoyable. In the fifth-period academic honors class, 11 out of 14 said they enjoyed the exercises. In the sixth-period class, 13 out of 14 said they did. Data is presented in Table 1.

Table 1.
Did Students Find Exercises Enjoyable or Meaningful?

Class	Yes	No	Percent Yes
1st Period	17	19	89
3rd Period	15	16	94
4th Period	17	18	94
5th Period	11	14	79
6th Period	13	14	93
Total	73	81	90

Regarding the second survey question concerning why or how the students did or did not enjoy the exercises, one student wrote that the topic was easier to understand, while another said that the exercises were quite interesting. "I have hoped that teachers would find some way to get us more involved for a long time," said the student. "Most classes are very boring."

Another student admitted being able to learn more about the country, while another said one could hear what everybody else thought about a country, since the comments were read out loud. Another person said the exercises opened the mind, while another said they were fun to answer.

Another said the students need to know what is taking place outside the United States, and the exercises helped. Someone else responded that the exercises caused one to think more and remember better the place being studied.

Another person said the exercises were enjoyable, even though the person did not like that the students were required to give their answer in front of the rest of the class. Another person said going around the class and hearing other students' answers allowed the students to understand each other better.

One student wrote that the exercises allowed for a better understanding of geography in general. Another said they were enjoyable and the topic could be learned well at the same time.

Another wrote that the questions allowed the student to think about different problems in other countries and express his or her own thoughts and feelings. Also, the student said, the exercises helped the majority of students to remember the topic better because they could relate to it.

Another person said that the exercises helped one look at the world in a different way, while another said, “It made me want to learn about the country with all the interesting facts” put in the reading.

One person wrote that going around the class and getting responses to the critical-thinking questions increased self-esteem. Another wrote that the questions involved the students’ more. Another said that the exercises gave more insight about a country than a textbook could.

Another said the exercises forced a student to apply the information in a personal way, while another mentioned that one could compare situations in other countries with those in the United States.

Another person said one could learn about these countries easier through the exercises than from a textbook, while another said that a boring subject was made more interesting.

Another found the exercise of planning a trip with a partner enjoyable, while another felt a part of the work. Another said the exercises were individualized.

Other responses to the second question were that the exercises kept the student involved, that they gave detailed perspectives, and that they were fun and did not seem like class work. Also, they made one think, they resulted in interaction with the teacher, and they made remembering and learning facts about a country easier and more interesting, the students said.

Of those who responded negatively to the first question, one person wrote that the questions were hard to answer because to answer them truthfully, one would have to visit those places. Another person simply said that the exercises were too much work and reading. Another negative responder said that the exercises were basically all that was done in class and that the students had to read their answers out loud, which that person did not like. The student who enjoyed the exercises only "somewhat" thought they could have gone into a little more detail and been more specific.

Other students who did not enjoy the exercises wrote that the work was pointless because the responses to the questions were not taken up and graded, and that the handouts were kindergarten level and boring. They also said that the only positive was that the student had a chance to be funny with the personal responses to the questions. Another said that nothing was really learned.

Regarding the third question as to whether the exercises added to a student's understanding of the topic being covered, 77 out of 81 said that they did.
Among the reasons given for why the exercises helped one better understand a topic were that the unit was better clarified, that the student learned something not known before, that more insight was given into the countries, and that one can see more easily the distinguishing characteristics of a country. Also, the topic was broken down better, the exercises help a student think more deeply, and one can learn about the experiences people went through in other countries.

Other responses for how the exercises helped the students better understand a topic were that the handouts and exercises put the topic in layman's terms, and that they were more in depth than is found in a textbook. Also, they gave the student the perspective of being in the country, and that they made one student want to go to some of those places. Also, they helped one formulate an opinion about a country, they allowed another student to relate more personally to the way life is lived in another country, they made one think more, and they enhanced the reading.

Also, students wrote that the exercises included facts that students would like about a country, and that they focused on single topics instead of on the more general topics covered in textbooks.

Negative responses to the third question were that the topic was already understood before being read, that the questions basically were opinion questions, that the questions were off topic, and that they dealt with "stupid" facts.

Concerning the fourth question, in which the students were asked to give suggestions about what other projects, in addition to, or instead of the exercises, the students might enjoy doing, a number of suggestions were offered. They included group activities, more hands-on activities, projects that deal with more pertinent facts about a country, and other games related to the countries. Other suggestions included doing map projects in which information about a city or place is put on a map, doing exercises that teach about the appearances of cities or rural areas, answering trivia questions or playing question-and-answer games, or actually going to the countries.

Other suggestions for alternative but engaging, exercises included tasting some of the food from a country, seeing some of the clothes from a country, and learning some of a country's language. Others included making poster boards about a place, playing games dealing with a country, doing individual research on a country and sharing it with the class, and taking real or fictional field trips.

Others included doing drawing projects, taking a non-graded short quiz at the end of a lesson, doing a skit about what was learned, making a postcard of the place, watching interesting videos about a topic, and making brochures or posters about a country. Also, they suggested doing group activities in which a different activities are done at different stations, learning the history of a famous leader of a country, doing group Internet projects, drawing on the blackboard, getting in touch with and hearing from someone living in a country, and flash-card games.

Conclusions and Recommendations

The results of the survey show that such exercises as I made the students do on my handouts are engaging and enjoyable to most people. The work also seems to increase interest in, and personal connection to, a geography topic being studied.

In hindsight, I realize that I should have tried to come up with different types of exercises for the students, while making sure they were still as engaging and personally involving as the handout exercises I used. In my second teaching placement, working with 8th-grade American history students at another school, I tried to come up with different exercises as well as continue to use ones similar to what I used in my geography classes. New exercises I developed included getting students to do a skit that includes information about a topic covered in a textbook, and getting students to draw and describe, in their own words, a famous historical invention. I also had students pretend they were part of a governmental body making decisions, and portraying a famous historical figure, myself, and getting the students to ask me questions about my life.

Another mistake I made was that I did not grade the handouts. Several of the students said verbally that the projects would have been more meaningful if the questions had been graded in some way. As a regular teacher, I will try to remember to include students' work on the exercises as some type of participation grade.

But overall, I feel that these survey responses show that engaging the students helps their learning and makes their time in class more meaningful.

Regarding the views toward such projects by professional geography and social studies teachers' organizations, I would say that they are supportive of such types of learning, based on some of the articles I read.

Offering some of these suggestions at a meeting or having other teachers with similar teaching philosophies gather for a brainstorm session or forum would be a great idea for teacher professional development, I believe. Although grant money is likely limited and I have not investigated the situation, I could easily see a Chattanooga philanthropic foundation or an organization, like the Carnegie Foundation, offering money for such teacher training, based on these positive results.

Technology would certainly be used in this type of teaching, whether to help someone find information for such handouts as I described, or to offer other creative and engaging lesson plans.

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Student Survey

As part of my student teaching work, I must conduct some kind of research and write a paper about it. I have chosen to investigate whether the exercises I do in class have made learning geography interesting for you, or if they have added to your understanding. If you could answer all of these questions, it will greatly help me in my research and writing. Thanks, and please do not put your name on this paper.

1) Have the enrichment classroom exercises that personally involve you been enjoyable or meaningful? (Examples of these are the questions at the end of the handout that are designed to get you to think a little more about the country or personally connect you with the country.)

2) If you did enjoy the exercises, state why or how you enjoyed them. If you did not, state why not.

3) Did the exercises add to your understanding of the topic studied? If so, how? If not, why not?

4) What other enrichment projects might you enjoy doing that might also help your understanding of a geography topic?

CHILDREN'S THEATRE

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Introduction

Children's Theatre in the United States, a 20th century movement, has grown from its original experiment in a New York settlement house in 1903 to hundreds of known groups operating throughout America today. The belief in the values of children's theatre has been a driving force through the years; in spite of difficulties and discouragements, its patrons and practitioners have succeeded in raising it from a little-known and irregular form of entertainment to the status of a nationally recognized branch of theatre.

In the early years, there was no clear-cut distinction between dramatic activities in which children participated and those that were designed for their entertainment. As the movement developed, clarification was made between children's theatre and creative dramatics. Our focus is children's theatre.

Although there is still some difference of opinion as to what constitutes children's theatre, it is here defined as living theatre intended for audiences of elementary-school-aged children. Adults, children, or a combination of both may perform it, and it may be either professional or amateur. A history of children's theatre encompasses work done in social settlements, community centers and civic theatres, and schools and colleges, as well as professional theatre. During the past 100 years, the leadership in children's theatre has shifted among these institutions.

Nurtured by educators, civic leaders, and artists, the children's theatre movement in this country has nonetheless led a chaotic existence since its beginning. When considering children's theatre and its origin, certain questions arise: Where did it come from? When and why was the first play for children produced? Who was responsible?

Once proclaimed by Mark Twain to be "one of the very, very great inventions of the twentieth century," children's theatre has been hailed by educators and community leaders alike as having the greatest potential of all the arts for learning. Winifred Ward (1958), credited with being the founder of Creative Dramatics, wrote, in 1939, that "The children's theatre in the United States is of very recent origin but no country perhaps, has at the present time more widespread interest in developing such a theatre" (p. 21).

Children's theatre in this country was not an accidental happening. It has remained, in general, independent of the adult professional theatre, though it has occasionally reflected some of the trends and technical skill of the adult art. Operating on a limited budget in virtually every instance, it has demonstrated more resilience than brilliance and more conservatism than experimentation. It is generally conceded, however, that what has been accomplished has been done through the efforts of those educators and theatre-lovers whose primary concern was, and is, theatre for children rather than an interest in personal or institutional gain.

For this reason, we find the earliest evidence of children's theatre in the social and educational centers of our larger cities, rather than on the professional stage. Drama was first introduced to provide wholesome entertainment and a method of learning for the youngest immigrants and most disadvantaged children in our society. The Junior League, a women's organization dedicated to social service in the community, was, according to all accounts, the first national organization to undertake a large-scale dramatic program. By the thirties, schools, colleges, and universities were beginning to play an important role in the development of children's theatre, and it is to the educational institutions that we now look for trends and guidance.

Like its adult counterpart, children's theatre is an art form. No other medium can evoke the same quality of response or satisfy the same human need for identification with characters in conflict. The values of children's theatre have been defined and defended by its proponents from the very beginning and, except in their wording, they have changed very little. Appropriate entertainment for young people, opportunity for learning, and appreciation of the theatre arts are the three most frequently stated reasons for offering stage plays to children.

The purpose of this paper is to trace the history of the children's theatre movement from its beginning to the present day. Our focus will be on each decade.

1900-1910

Acknowledged by all authorities to be the first significant theatre for children, the date of the founding of the Children's Educational Theatre has become the date of the movement. The date was 1903 and Alice Minnie Herts was the director. The Children's Educational Theatre had a definite educational policy governing production, it established a budget, and it maintained high standards in the selection of plays, acting, and staging. While it lasted only 6 years, it was an excellent and influential undertaking.

The Children's Educational Theatre closed in 1909, but only a short time passed until its rebirth, 2 years later, as the Education Players. While it was under different management, it held to the principles laid down by Miss Herts. According to Constance D'Arcy Mackay, who was at the time closely following children's dramatic activities, a significant thing happened which, she believed, was a result of Miss Herts' work. For the first time, plays for the public schools were being written and published. In 1911, the

Education Players began to work in connection with the public schools; the players were adults, with children as spectators rather than as co-players (Hertz, 1911).

The influence of the original Children's Educational Theatre could hardly be overestimated. Beyond such outcomes as the one mentioned above were statements made on its behalf. Among them was an endorsement by Garfield W. Moses. Moses' comment in *Charities and the Commons* stands as a prediction that has been fulfilled:

> This Children's Theatre will grow from more to more. In its very nature it is not a local institution or a mere adjunct of settlement work. It should reach children of all classes and all conditions. Through it the future educational drama may be shaped, and this drama, of course, is not to be confined to one section or one class. (Anon., 1907, p. 32).

Moses went on to say that America needed a real theatre for children which should be housed in a building of its own, equipped for the purpose. To this end, he continued that there must be developed authors who would write children's plays just as certain men and women have concentrated on the specialized field of children's books.

No other children's theatre group had attracted so much attention nor had so much written about it by those most closely connected with its functioning. The importance of Children's Educational Theatre would seem to lie in two factors: that it was the first organized children's theatre in the United States and that it adhered to a definite policy of educating its members and its audience, through an insistence on the best in both dramatic literature and standard of public performance.

1910-1920

An important date in the history of children's theatre was 1910, the year in which the Drama League of America was founded in Evanston, Illinois. The Drama League was not primarily concerned with children's theatre, but it did emphasize the best in literature on all levels, and established within its organization a Junior Department, under the direction of Cora Mel Patten. With the help of Mrs. Patten, children's leagues were established in many large cities, and pageants and plays were produced for child audiences.

The League's aim was to establish a chapter in every town and city in the country, and thereby launch a nationwide campaign to support so-called "good" drama and discourage by nonsupport "bad" drama. The League was apparently influential in encouraging the appreciation of dramatic literature and in establishing, through its chapters, a number of community playhouses. In 1913, at its convention in Detroit, the League decided to promote interest in little theatres, and for many years, ran a placement bureau and acted as a clearinghouse for directors of these groups. The League sponsored a magazine, *Drama*, and for 20 years (1911-1931); it carried articles, both informative and critical, on all phases of the theatre. (Anon., 1930, p. 139).

An important contribution made by the Drama League was the compilation and distribution of lists of plays suitable for children's use, together with suggestions on production. These lists were available in *Drama*. Meanwhile, believing the needs of schools and social centers were still unmet, the Educational Drama League was organized in January, 1913. The object of the Educational Drama League was the promotion of amateur dramatics in the public schools, social settlements, and civic centers. The Educational Drama League provided the same service as the Drama League of America, making books, scripts, and materials available for clubs and schools, where the ages ranged from 7 to 20.

Winifred Ward, looking back at the work of the League in 1939, paid it high tribute when she stated that the history of children's theatre in America began with this organization: "In the awakening of general interest and dissemination of knowledge concerning children's plays, the Drama League of America deserves highest credit." (p. 23).

1920-1930

New dramatic groups and different types of organizations appeared in the early 1920s. One outstanding example is the Association of Junior Leagues of America, a large organization of women whose work has always been of a philanthropic nature, which today ranks as one of the strongest contributors to the children's theatre movement.

As early as 1912, Junior League ladies were gathering in New York, Chicago, and Boston to present plays for children. It was not until 1921, however, that it began a program that was to become one of the most important contributions to the children's theatre movement. The year 1921 marked the beginning of formal children's theatre activities among the Leagues, independent of settlements and institutions. It was in this year that the Junior League of Chicago gave *Alice in Wonderland*, a lavish production in a downtown theatre. While the players were amateurs, the staff was professional and newspaper publicity was exceptionally good. The success of the performance was measured by its enthusiastic reception and excellent financial returns.

The success of the Chicago venture stimulated activity among other chapters, and by 1926, Leagues in 14 different cities were producing children's plays. Within another year, these efforts were receiving a new kind of support. Samuel French had agreed to publish adaptations of *The Wizard of Oz* and *Raggedy Ann,* with music by Ira S. Holden, thus making printed scripts available of these popular children's plays. The Junior League Magazine added a new section called "The Play Box" in which articles, questions, and answers pertaining to children's entertainment appeared. With this added support from the national headquarters, activity swelled and by March 1928, 52 Leagues were offering children's plays.

The purpose guiding the work was stated to be the entertainment of boys and girls and the building of adult audiences by introducing the young to theatre production. Unlike community theatres, which utilized children in their performances, the Junior League plays were acted by adults. Since the number of good full-length players was still scarce, the policy of writing their own scripts was established. From the first, successful manuscripts were filed for future use, thus forming the nucleus of a play bureau which was to expand and become an important part of the program.

A publication of the Junior League, in which the history of this enterprise is recounted, states that "Theatre meets a fundamental need of human beings. It allows them to enter worlds larger than their own, to encounter people different than themselves, and to share experiences that may never exist in everyday living" (Ciaccio, 1951, p 5).

1930-1940

The years 1930-1940 were unhappy years in American theatre history. The financial depression which struck the country dealt Broadway a savage blow. While Broadway was suffering from the crippling effects of the depression, theatre for children survived. Since the commercial theatre had never played a major role in its development in this country, drama for children did not suffer from the bankruptcy of producers or from diminished commercial production. The advent of the Federal Theatre, however, did affect juvenile entertainment and became, within the span of its three 3-year existence one of the most vigorous enterprises in children's theatre history.

The Federal Theatre, an emergency relief measure offering entertainment to the public and employment to actors, was established on April 8, 1935, by Congress, under the direction of Hallie Flanagan of Vassar College. According to Flanagan, three important points were made at the time of its founding: persons employed were to be taken from the relief roles of the states; to those employed, work was to be offered within their own skills and trades; and those who could not do the work were to be retuned to the care of their states. (Flanagan, 1940, p. 16). Theatre leaders who attended the first meeting of regional and state directors in October 1935 represented many kinds of background and achievement. The aim of these leaders was to set up theatres which could grow into social institutions in the communities in which they were located, thus providing possible future employment for at least some of the persons connected with them.

Statistics compiled from the files of the National Service Bureau in Washington revealed that drama for children was presented in the several cities throughout the country during those years. One of the cities in which activity was most extensive was New York. On June 2, 1936, the Federal Children's Theatre opened at the Adelphi Theatre with *The Emperor's New Clothes*. Reviews were good. After its initial run, it was taken on tour and played on portable stages in parks. Over 100,000 persons, mostly children, were said to have seen it in the following 6 weeks.

Despite Flanagan's satisfaction with the results of the project and the energetic reception it received in many parts of the country, the Federal Theatre, including the

Federal Children's Theatre, was ended by an Act of Congress, for economic reasons, on June 30, 1939.

1940-1950

The transition from depression to war and postwar periods brought inevitable changes to every aspect of American life. Cultural institutions, in particular, felt the impact of these changes. The professional theatre was stimulated to an extraordinary degree and children's theatre, both amateur and professional, was also affected. Because of increased interest, there was more entertainment offered for children in the 1940s than in any pervious period (McCaslin, 1971, p. 122).

The Children's Theatre Conference, established as the Children's Theatre Committee in 1944, dedicated itself to the children's theatre movement. Unlike other national organizations, it was founded for the express purpose of promoting more and better theatre for children throughout the United States. At the invitation of Winifred Ward, members of the Children's Theatre Committee of the American Educational Association gathered for a summer meeting on the campus of Northwestern University, Evanston, Illinois, in 1944. Some 80 leaders of children's theatres from all over the country attended. A Children's Theatre Directory prepared by the Children's Theatre Committee was published and distributed by the American Educational Theatre Association. A Play Standards Committee was organized to set up standard requirements of good plays for children and to help arrange trial productions of all promising new works. A Children's Theatre Bibliography was prepared in which books and articles on children's theatre subjects were listed. In 1950, a newsletter with a national coverage of children's theatre was first published. Finally, a Placement Service was inaugurated, through which both producing groups and directors could be served.

The increasing membership in the organization, the publications which it sponsored, and the widening scope of its activities indicate that, by the end of the 1940s, the Children's Theatre Committee had become a strong and influential body. It is also significant that while different types of organizations were represented in it, the colleges and universities played host to its meetings and assumed the major share of responsibility for its growth and development.

1950-1960

The movement toward unification of children's theatre which first appeared in the 1940s continued into the 1950s. Three significant events took place. First was the Mid-Century White House Conference in 1950, at which children's theatre was a point of consideration. Second was the change in status of the Children's Theatre Committee, which after 1952 officially became the Children's Theatre Conference, a division of AETA. Finally, there was the establishment of 16 regional organizations under the aegis of the Children's Theatre Conference.

The Mid-Century White House Conference on Children and Youth brought to Washington in December 1950 some 6,000 delegates. The significance of aesthetic experience and artistic expression for healthy personality development was the topic in 1950; this subject claimed the attention of leaders in educational and community theatres from various parts of the country. Implications for children's theatre in this conference were to be found in the following statement: "The very essence of theatre lies in the interrelation of human beings and used properly in the educational process, drama can richly aid healthy personality development in children and youth" (Comer, 1951, p. 222).

Objectives, which grew out of this conference, were the securing of recognition and more effective functioning of drama in the total educational scheme, the encouragement of opportunities for children to see and participate in theatre during leisure hours, the development of a sound body of knowledge, and an attempt to deepen the understanding of life.

After the conference, the Mid-Century Committee for Children and Youth was organized, with Leonard W. Mayo as chairman. Its plans included the publication of a bulletin and providing of information and field services for interested groups throughout the United States. Leaders of the educational theatre named three areas in which a contribution might be made. These were self-evaluation of both individuals and groups, a more effective functioning through closer ties and cooperation with community groups, and a long-range program of research on activities already established. Since children's theatre was included in the educational theatre program, the implications for its future contribution were stated in these aims.

1960-1970

The long desired dream of government aid to the arts was finally realized in the 1960s. The most important and far reaching programs were the National Foundation on the Arts and Humanities Act of 1965, the two branches of which were the National Endowment of the Arts and the National Endowment for the Humanities; and the Elementary and Secondary Education Act (ESEA) of 1965, administered by the Department of Health, Education, and Welfare. Under ESEA's Title I and Title III, a number of children's theatre activities were made possible. In addition, there was the Economic Opportunity Act of 1964, which also contributed to children's drama.

The National Endowment for the Arts still operates under the guidance of the National Council on the Arts. The Council is responsible for assisting in a variety of services, including pilot projects in the arts, and advisory and consulting services for foundations, educational institutions, public and private groups, and councils. The programs administered by the Endowment on the Arts are set up to:

1. Stimulate enjoyment and appreciation of the arts by creating the widest possible audience for arts activities of substantial artistic and cultural significance.
2. Encourage and assist individual performing and visual artists to achieve standards of professional excellence.
3. Develop and expand the capacity of independent arts institutions and organization for imaginative and substantive programs.
4. Explore the problems of the arts in American in order to develop new programs and institutions to meet existing and future needs.
5. Encourage imaginative arts programs in the field of education.
6. Support international arts events. (Gault, 1967, Introduction)

The National Endowment for the Arts receives and allocates private, as well as government, funds to establish programs or implement programs of grants-in-aid to agencies and individuals. This large-scale recognition of the arts on the part of the federal government was indicative of a new direction in the nation's cultural growth.

1970-1980

Until this time, children's theatre concerned itself with scripts based on fairy tales, but for the first time in the history of the children's theatre movement, serious questions were raised concerning the relevance of this traditional material in a time of social change, and efforts were made to find new scripts with greater meaning for children. Violence was viewed in a different light; while criticism of television and film programs persisted, there were some adults who spoke out against fairy tales and "happy endings"

(McCaslin, 1971, p. 209). Why could there not be children's plays that dealt with contemporary themes? Children's plays did not change radically as a result of this questioning, but for the first time since the 1930s there were some scripts with contemporary social themes. This is, at least in part, thanks to one children's playwright in particular.

Suzan Zeder has began a new wave of children's theatre by taking real life issues that children face and making them into compelling stories that help a child to understand difficult issues. For example, her play *Doors* tells an extremely realistic story of divorce, from the child's perspective. She deals with the pain involved with hearing parents arguing in the room next door, and the pain of separation. She does all this in a non-preachy manner that is simply a story of what a child goes through. In another play, *Step on a Crack,* she approaches the subject of coping with a stepmother, while completely avoiding the evil stepmother convention. All of her plays are realistic stories about children. She, herself, has said that she writes about children, as opposed to for children.

Suzan Zeder also has many plays that are not as serious as *Doors* or *Step on a Crack*, but all of her plays are equally honest and compelling. She has adapted *Ozma of Oz* and has written many original titles such as *Wiley and the Hairy Man* and *Mother Hicks*. All of her plays add to a new awareness that children's abilities to comprehend serious material have been, for a very long time, underestimated. Her plays give credit to children for being extremely intuitive and intelligent, particularly when it comes to recognizing truth on a stage (MEC & JWQSVV, 1996).

1980-1990

In the opinion of many, the most important happening of the decade was the creation of the International Association of Theatres for Children and Young People, known as ASSITEJ. This was the first organization to give critical attention to children's theatre on a worldwide scale. For many years, Americans traveling abroad had returned with glowing accounts of work done for children in other countries. They praised, particularly, the casting of professional actors in children's plays and the respect afforded children's theatre by government and artists alike. With the formation of ASSITEJ, a new chapter in the history of the movement was about to be written.

Aurand Harris, a man who has written a tremendous body of contrasting plays for young audiences, went into China on the heels of Arthur Miller's, the first ever American playwright to direct a play in China, *Death of a Salesman* production. At the request of the Shanghai Children's Art Theatre, the oldest children's theatre in China, and the funding of the International Association of Theatres for Children and Young People, Aurand directed the first ever production of an American children's play in China. The play, *Rags to Riches*, was translated into Chinese and performed by Chinese actors. Of course, the Chinese government did require some "changes" in the script to accommodate for the political and economic differences between the two countries, but nonetheless, Aurand would become not only a bringer of joy to American children, but now, to children around the world.

The International Association of Theatres for Children and Young People is still thriving today and operating under the auspicious mission of "enriching the lives of children and young people by uniting individuals, professional theatres and theatre organizations in raising the artistic standards of theatre for children and young people."

1990-2000

An overview of this decade must, of necessity, be left for another time in the not so distant future. In the first place, the very proliferation of activities would make a description of each group run literally into volumes. In the second place, the comprehensive Directory of Children's Theatres in the United States, published by the American Educational Theatre Association, lists all known groups with pertinent information. It would be premature to attempt to cite the most important of influential groups; time will prove which are the most significant.

Conclusion

In 1956, Robert Kase declared that children's theatre had come of age. By 2003, however, though more firmly entrenched and widespread, children's theatre cannot yet claim to have achieved full stature. A number of problems must still be solved before children's theatre can take its place as a full-fledged member of the family of the performing arts in the United States. The 100 years since its birth have been witness to a variety of changes, expansion of activities, and some experimentation. Most important, however, has been the acceptance of the values of theatre among educators and laymen alike. Some of the same problems, which have hampered its growth from the beginning, still exist; the solution of these problems will inevitably affect the direction theatre takes in the future.

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Name: Answer Key – Pre-test

1. When did Children's Theatre begin to grow as a respectable branch of theatre in the United States?
   1900's
2. Define Children's theatre.
   Nonspecific, global term indicating the general field of theatre as applied to children
3. What is the age range for Theatre for Children?
   Elementary school age, 5 to 12
4. What is the age range for Theatre for Youth?
   Junior High School age, 13 to 15
5. Who may perform Children's Theatre?
   Adults, children, or a combination of both
6. Define Creative Drama.
   Improvisational, non exhibitional, process-centered form of drama in which participants are guided by a leader to imagine, enact, and reflect upon human experiences
7. What was Charlotte Chorpenning's major contribution to Children's Theatre?
   She doubled the mid-century repertoire for children's theatre by herself.
8. What is Winifred Ward credited as being the founder of?
   Creative Drama
   (Will also accept AATE)
9. What play did Aurand Harris direct in China?
   Rags to Riches
10. What type of subject matter does Susan Zeder address in her playwrighting?
    Real life issues children face

Bonus: Define Participation Theatre
Inclusion of structured opportunities for active involvement by all or part of the audience in the performance

Name: Post-Test Answer Key

1. When did Children's Theatre begin to grow as a respectable branch of theatre in the United States?
Early 1900's

2. *Children's Theatre* is the nonspecific, global term indicating the general field of theatre as applied to children.

3. Five (5) to twelve (12) is the age range for what?
Theatre for Children

4. Thirteen (13) to fifteen (15) is the age range for what?
Theatre for Youth

5. Who may perform Children's Theatre?
Adults, Children, or a combination of both

6. Define Creative Drama.
Improvisational, non-exhibitional, process centered form of drama in which participants are guided by a leader to imagine, enact, and reflect upon human experiences.

7. Who doubled the mid-century repertoire for children's plays?
Charlotte Chorpenning

8. Who founded Creative Drama?
Winifred Ward

9. Who directed Rags to Riches? In what country was it directed?
Aurand Harris *China*

10. Who addresses real life issues in their playwrighting?
Susan Zeder

Bonus: Define Participation Theatre.
Inclusion of structured opportunities for active involvement by all or part of the audience in the performance.

Grade Level(s): 6-8

Subject: Intermediate Theatre for Middle School (4A and 4B)

Time/Duration: 90 minutes

Lesson Sequence: Day 1

Title: Children's Theatre Lecture

Goal: To introduce students to history and influential leaders of Children's Theatre in the United States.

Objective: Students will be able to:
-Recall when children's theatre began to grow as a respectable branch of theatre in the United States
-Recognize and define terms relevant to children's theatre
-Identify four adult leaders in American children's theatre and their major contributions

Preparation:
Space: Classroom – students in chairs arranged in a circle
Equipment: chalk, chalk board, lecture notes, pre-test

Procedure:
-students will enter classroom and take their seats
-pre-test will be administered to assess student's prior knowledge of children's theatre
-lecture notes will be given
-class discussion over lecture notes

Name: ____________________ **Block:** ____________________

Children's Theatre – nonspecific, global term indicating the general field of theatre as applied to children.
-Began to grow as a __________ branch of theatre in the United States in the early _____
-Earlier in other countries such as _______ and _______ primarily due to the respect that these countries hold for minds and intellects of children

Theatre for Young Audiences (TYA) – term encompassing "Theatre for Children," and "Theatre for Youth," the distinction being the ______ ________ of the intended audience.

Theatre for Children – indicates theatrical events specifically designed to be performed for young persons typically of the ___________ school age, ____ to _______.

Theatre for Youth – indicates theatrical events specifically designed to be performed for young persons typically of the _______ _____ school age, _____ to _____.

TYA

-Performance may be based on written, adapted, devised and/or improvisational scripts
-Material for performance may be a _________ story line or it may be a ________ of shorter, separate thematically relates stories or sketches
-Performers may be adults, ____________, or a combination of both
-Full spectrum of theatrical arts and crafts may be utilized to enhance performance (i.e., lights, costumes, sound, props, etc.)

Participation Theatre – inclusion of ______________ opportunities for active involvement by all or part of the _____________ in the performance

Creative Drama – improvisational, ___________________, process-centered form of drama in which participants are guided by a leader to imagine, enact, and reflect upon human experiences

--Some major influences in the field of TYA throughout the 20th century--

Charlotte Chorpenning

-60 yrs old when she began writing children's plays and working as artistic director for the ____________ Theatre in Chicago
-From the day she began writing to the day she died, she managed to _________ the mid-century repertoire for children's plays by _________

-Typically adapted well-known titles such as Little Red Riding Hood, The Emperor's New Clothes, etc. She did this based on the premise that children would more interested in going to see plays that they recognized the titles of.
-After her death the Charlotte Chorpenning Award was established. Each year the award is given to a _____________ who has written a body of plays that lift up the field of children's theatre.

Winifred Ward

-Credited with being the founder of ___________ _______ (1918)
-Founded the American Alliance for Theatre and Education (AATE) in 1944; this is the first national child drama organization and it is still thriving today

Aurand Harris

-Written a tremendous amount of contrasting plays for young audiences including a vaudevillian show, a melodrama, and a death show.
-In addition to his original writings he also adapted traditional stories
-Received the Charlotte Chorpenning award ________
-Directed the _______ ever production of an American children's play in China (1980's). The play was _______ ____ _________ and it was translated in to Chinese and performed by Chinese actors.

Susan Zeder

-Has begun a new wave of children's theatre by taking ______ ______ _________ that children face and turn them into compelling stories that help a child understand difficult issues.
-*Doors*-realistic story of divorce from the child's perspective. *Step on a Crack*-coping with a stepmother while avoiding the evil stepmother convention.
-Her plays give credit to children for being extremely intuitive and _______________

Grade Level(s): 6-8

Subject: Intermediate Theatre for Middle School (4A and 4B)

Time/Duration: 90 minutes

Lesson Sequence: Day 2 – 7

Title: Children's Theatre – Rumplestiltskin

Goal: to give students the opportunity to participate in the rehearsal and production process of a children's theatre production.

Objectives: Students will:
-Identify characters in the story of Rumplestiltskin
-Recall the sequence of events in the story of Rumplestiltskin
-Identify unfamiliar vocabulary from the story of Rumplestiltskin

Preparation:
Space: Classroom – chairs will be arranged in a circle
Equipment: chalk, chalk board, lesson plan notes, Rumplestiltskin.

Procedure:
-Students will enter classroom and take their seats.
-Students will read the story of Rumplestiltskin.
-Students will be asked to identify the characters of the story.
-Students will be asked to recall the sequence of events in the story.
-Students will estimate where the events in this story took place.
-Students will identify unfamiliar vocabulary and meanings will be discussed.
-Items identified/recalled will be written on the board.

Plan:

Characters:	Location:	Events:
Rumplestiltskin	Woods	Rumplestiltskin in the woods
The Candle maker (Ashley)	Candle shop	Ashley tells Sarah that Katie can spin straw into gold
Sarah	Town Street	Sarah tells the townspeople
Katie	Castle	Guards tell king
Townspeople	Spinning Room	King sends for Katie

King	Garden	Katie is asked to spin straw into gold
Queen		Rumplestiltskin spins straw into gold
Prince		Katie put to second test
Guards		Rumplestiltskin spins straw into gold
Narrator		Katie put to third test
Courtiers		Rumplestiltskin spins straw into gold
		Katie and prince are married
		Katie and prince have a child
		Rumplestiltskin comes to claim child
		Katie is given three chances to guess his name
		Guards discover Rumplestiltskin's name
		Katie wins name game
		Rumplestiltskin is taken away
		They live happily ever after
		The End

Vocabulary:
Naive – adolescent; youthful; small child
Suitor – someone who seeks to marry a woman
Astronomy – the science of objects and matter beyond the earth's atmosphere
Solar System – the sun together with a group of celestial bodies that revolve around it
Avarice – greed
Sire – Lord, a form of address and/or title
Spinning Wheel – machine for spinning thread or yarn
Maiden – a young, unmarried woman
Decreed – ordered
Spouse – husband or wife

Assessment:
Rules for Rehearsal Etiquette:
-Always bring script and pencil
-Always be ready to work mentally and physically
-Do not interrupt the artistic process
-Be here and be on time
-Meet deadlines
    -Field trip from due February 12 – 4A & February 12 – 4B
    -All black required for costumes February 10
    -Off book February 7 – 4A & February 6 – 4B

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GENDER BIAS IN THE SCIENCE CLASSROOM:

AN ANALYSIS OF THE SCIENCE TCAP ACHIEVEMENT TEST FOR 2002

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Gender Bias in the Science Classroom:

An Analysis of the Science TCAP Achievement Test for 2002

Introduction

According to literature, national statistics show a profound gender gap in the sciences, especially in the field of physics. As a future physics instructor, it is important that I examine the nature of this gap, if it is present, in local and state schools. The gender gap in science is at variance with research that shows similar levels of positive interest in science in both boys and girls in the seventh grade. In addition, "nine as well as thirteen-year olds' performance on national science proficiency tests does not significantly differ by gender" (Chapman, 1997, p. 75). In spite of this, beginning in junior high and on into college, all students, and especially girls, begin to lose interest in the sciences. In order to address this inequality, the history of gender bias in science, the differences in male/female behavior, and the actions of teachers, implicit or explicit, are just a few factors that must be examined.

Literature Review

The history of gender bias against women and girls in science education is well documented in Jeffe's (1995) "About Girls' 'Difficulties' in Science: A Social, Not a Personal, Matter." In our modern society, it is commonly believed that the "difficulties [in science] 'belong' to women, that women's personal characteristics are to blame . . . By extension, such attribution to women's personal characteristics can lead to a conclusion that women make these difficulties for themselves" (p. 207). Contrary to this idea, the evidence shows a concerted effort within society to limit the involvement and encouragement of females in the sciences throughout the 20th Century. There is a long and unfortunate history of limiting female education where it seemed to threaten socially acceptable roles. While sexual bias and discrimination are certainly not as prevalent as they were a century ago, this history must be recognized as a social problem and not one inherent to the female mind.

One place this history manifests itself is in the curricular materials present in the classroom. For example, in "Gender Bias: Inequities in the Classroom," Love (1993) reviewed science texts in which "boys controlled the action and demonstrated the various scientific principles while girls observed" (p. 8). This printed bias is unfortunately reflected directly in the classroom with boys often being those who physically do the science, while girls often are record keepers. Rather than a direct result of the textbook, it is more likely that the textbook reflects the bias already present in society that resulted in the classroom behavior. Nevertheless, the text does serve to reinforce this bias.

The differences in boys' and girls' behavior, whether inherent or socialized, are a valuable tool for the gender-conscious teacher. Judy Mann (1994) points out several differences between the sexes that are important to consider in the science classroom. For instance "boys interrupt and command the attention of teachers while girls raise their hands politely and wait." This behavior can lead to boys being paid much more attention than girls, and often "girls are left to feel muted, invisible, and less important" (p. 2). While these differences are not necessarily an impediment to learning science, the way they are reacted to by teachers can reinforce the perception that the subject is a cold and isolated masculine pursuit. It is important for teachers to examine their own biases, most of which are subtle and difficult to recognize. If the differences in behavior of girls and boys are not taken into account, teachers can sometimes fail to deal with the specific needs of female students in a field that has been inclined towards males for most of this century.

"It's Not My Style: Using Disclaimers to Ignore Gender Issues in Science" focuses on an imaginary student teacher named Hank who is not comfortable with the theoretical methods of gender inequality in the science classroom. Believing that the gender gap is a problem of the past and that "things are equal now," Hank considers suggested methods of dealing with a bias are not only unnecessary, but an interference to what he believes to be his style of teaching. Like Hank, "most people only consider gender inequity a problem when the inequity is very blatant, such as in cases of sexual harassment. Participants in classroom life hardly notice subtle classroom inequities" (Bailey, Scantlebury, & Letts, 1997, p. 32).

This denial of the problem leads to a gender blindness that ignores differences in behavior that were developed in the past. Hank assumes that if he presents the science properly, both boys and girls will understand. In doing so, he fails to realize a female student's quiet behavior is not that of understanding, but a manifestation of her own despair at her lack of it.

As Hank failed to realize, the science curriculum espouses masculine learning techniques, whether the difference between masculine and feminine techniques is rooted in socialization or innate qualities of the sexes. Chapman (1997) identifies the "masculine world view" of most men who have done science in the past as one that "tends to value autonomy, distance, and an ability to keep a tight, sharp focus while ignoring context considered irrelevant." She believes that this approach does not come easily to women and girls as it conflicts with female socialization (p. 77). When girls fail to grasp a subject that is presented at variance to their worldview, teachers can sometimes mistake this for inherent lack of understanding or lack of effort.

The socialization of girls is different than boys in that they are encouraged "to be cooperative relationship- and context-oriented, whereas the common style of science teaching emphasizes individual work, competition, analysis of discreet detail, and obstruction from context" (Chapman, 1997, p. 76). These differences can be exploited to the benefit of both male and female students by making the classroom friendlier to girls and allowing boys to consider science from a different perspective. One activity that is easily integrated into the science classroom is that of group activities and collaboration. "Many students, including girls, are more comfortable speaking up in small-group settings or when working in pairs" (Wood, 2000, p. 33). By encouraging students to attack problems in small groups, the shyness of some girls can be overcome, in addition to accessing their desire to work cooperatively, rather than competitively.

When creating group situations, Sanders (1994) makes multiple suggestions to avoid allowing the bias to continue into the group situation. For instance, lab teams can be divided into single sex groups or groups with stronger girl than boy members. Very important in the process is continued monitoring of whether grouping is actually accomplishing the desired result. In order to do this, teachers are encouraged to question students as to their preferences and feelings regarding mixed and single-sex groups and to change the groupings frequently in order to observe which situation is best (p. 91).

While grouping girls separately from boys may help address gender bias in some situations, it should not be taken as a cart blanche solution. In fact, the idea that girls don't succeed in science simple because of the presence of boys is a widespread myth. Another myth, surprising to some, is that women teachers are not necessarily better at teaching girls science. In "Girls Are . . . Boys Are . . . Myths, Stereotypes, and Gender Differences," Campbell and Storo (1996) state that "While teachers treat male and female students differently, this is true for both female and male teachers. The gender of the teacher has little or no effect on how they treat girls and boys" (p. 5).

With regard to the general effort of teachers to reduce inequity in the classroom, Shmurak and Ratliff (1993) found that "no unified effort is being made by most teachers of most middle schools to promote equity" (p. 11). As with Hank, in the before- mentioned story, Shmurak and Ratliff (1993) also discovered that "teachers' perceptions about their sensitivity to gender equity seldom matches their actual practices" (p.11). This disturbing trend was matched with a surprising one in that middle school students were often more equity-conscious than their teachers. While this fact is encouraging in that students are learning what their teachers should know, it is unfortunate that so many teachers appear to be denying a problem that their own students clearly recognize.

In spite of still existing problems, there are some encouraging statistics that indicate the gap between girls and boys in math and science is decreasing. "During the 1990s, female enrollment increased in many math and science courses . . . Girls are now more likely than boys to take biology and chemistry courses, while physics is still a male domain." However, "Tests continue to reflect a gender gap, particularly high stakes tests like the SATs" (Sadker, 1999, p. 25). These facts indicate that there is progress being made against gender bias in the science classroom, but there is still much work to be done.

Given the large amount of information available to teachers on how to create a more equitable classroom, science teachers need only recognize that there is a problem, and there is much that can be done to correct it. If teachers can look inward and learn to discover their own biases, they will have taken the first and most important step in repairing the gender gap.

Data Collection and Results

The Tennessee Comprehensive Assessment Program (TCAP) Achievement Test is an ideal tool to measure the gender gaps that exist within the classroom. Every spring, the test measures the performance of all students in grades 3-8 in the areas of reading, vocabulary, language, language mechanics, mathematics, mathematics computation, science, social studies, spelling, and word analysis. Both content and application knowledge are tested in these subjects. Published by CTB/McGraw-Hill, the TCAP Achievement Test provides norm-referenced results in the form of median national percentiles that are compared to a national sample of students (Tennessee Department of Education, 2003C).

The science portion of the test contains questions covering the concepts of science inquiry, physical science, life science, earth and space science, science and technology, and personal social perspectives in science. Students in Grade 3 receive a 35-question test, and students in Grades 4-8 receive a 40-question test. All questions are multiple-choice, and students are given 1 minute per question, resulting in a 35-minute test for Grade 3 and a 40-minute test for Grades 4-8 (Tennessee Department of Education, 2003D).

The results from the 2002 TCAP Achievement Test are posted in PDF format on the Tennessee Department of Education website. These scores were downloaded and converted to Microsoft Excel format in order to perform an analysis of test results. The median national percentile in Table 1 is organized by grade and by gender, and includes the median national percentile for all subject areas. Table 2 shows the results for Hamilton County.

Table 1

2002 State-Wide TCAP Achievement Test Results by Gender

			Median National Percentile				
Grade	Sub-Group	Total number	Read. Comp.	Lang. Comp.	Math Comp.	Science	Social Studies
3	Female	33926	61	70	67	41	49
3	Male	35742	56	59	66	46	49
4	Female	34913	59	68	62	47	56
4	Male	36816	54	54	59	51	54
5	Female	34937	56	63	64	49	49
5	Male	36305	55	48	61	56	49
6	Female	34291	52	66	54	51	51
6	Male	36234	49	51	51	54	51
7	Female	32388	55	69	59	44	56
7	Male	35042	51	49	55	48	54
8	Female	32517	55	69	54	53	49
8	Male	33559	53	49	53	56	52

Source: Tennessee, Department of Education (2003b). Statewide results broken down by subgroups [TCAP].

Table 2

2002 Hamilton County TCAP Achievement Test Results by Gender

			Median National Percentile				
Grade	Sub-Group	Total number	Read. Comp.	Lang. Comp.	Math Comp.	Science	Social Studies
3	Female	1520	56	69	66	41	45
3	Male	1544	54	59	62	43	45
4	Female	1550	56	66	56	43	53
4	Male	1652	53	54	55	48	52
5	Female	1558	55	61	58	46	47
5	Male	1625	49	48	55	52	48
6	Female	1591	48	61	48	47	47
6	Male	1638	47	50	46	50	49
7	Female	1603	48	62	50	41	50
7	Male	1557	48	47	50	43	49
8	Female	1450	53	66	47	49	49
8	Male	1479	53	49	50	54	51

Source: Tennessee, Department of Education (2003). 2002 TCAP Achievement results.

Tables 3 and 4 show the difference between the male and female score according to the equation for state-wide results and Hamilton County results, respectively, according to the equation:

Difference NP = Female NP – Male NP

Table 3

2002 State-Wide TCAP Achievement Test Differences by Gender

		Difference in Median National Percentile (Female NP - Male NP)				
Grade	**Total number**	**Read. Comp.**	**Lang. Comp.**	**Math Comp.**	**Science**	**Social Studies**
3	69668	5	11	1	-5	0
4	71729	5	14	3	-4	2
5	71242	1	15	3	-7	0
6	70525	3	15	3	-3	0
7	67430	4	20	4	-4	2
8	66076	2	20	1	-3	-3

Source: Tennessee, Department of Education (2003b). Statewide results broken down by subgroups [TCAP].

Table 4

2002 Hamilton County TCAP Achievement Test Differences by Gender

		Difference in Median National Percetile (Female NP - Male NP)				
Grade	**Total number**	**Read. Comp.**	**Lang. Comp.**	**Math Comp.**	**Science**	**Social Studies**
3	3064	2	10	4	-2	0
4	3202	3	12	1	-5	1
5	3183	6	13	3	-6	-1
6	3229	1	11	2	-3	-2
7	3160	0	15	0	-2	1
8	2929	0	17	-3	-5	-2

Source: Tennessee, Department of Education (2003a). 2002 TCAP Achievement results.

Results for the science portion of the TCAP Achievement Test were graphed for both state-wide (Figure 1) and Hamilton County (Figure 2) results in order to illustrate the gap between male and female performance.

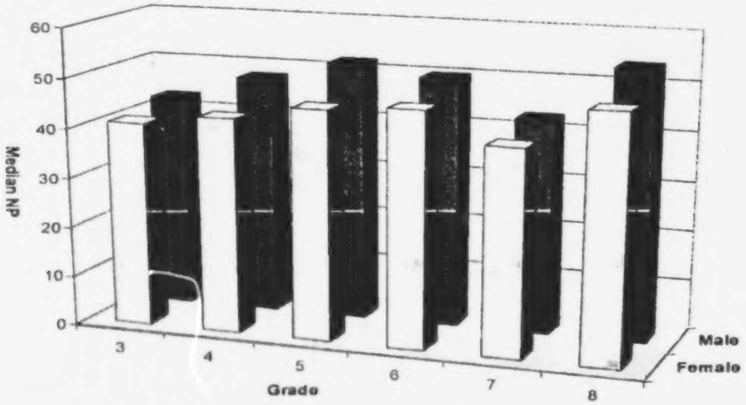

Figure 1
2002 State-wide Science TCAP Achievement Test Results by Gender.
Source: Tennessee Department of Education (2003b). Statewide results broken down by subgroups [TCAP].

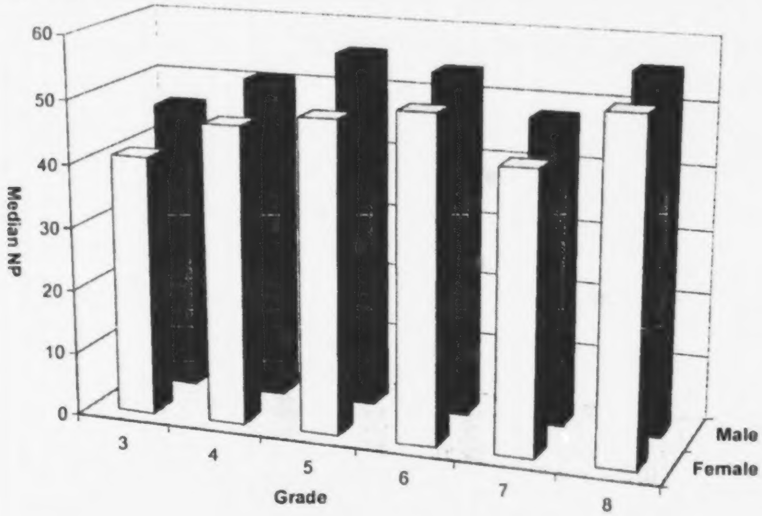

Figure 2
2002 Hamilton County Science TCAP Achievement Test Results by Gender.
Source: Tennessee, Department of Education (2003a). 2002 TCAP Achievement results.

Analysis of Results

As shown in Table 3, state-wide there is a gender gap in the median national percentile of the science portion of the state-wide TCAP Achievement Test. Surprisingly, there is little variation from grade to grade. In fact, the largest difference in scores occurs in the third and fifth grades with a difference of -5 percentile points, and -7 percentile points respectively. This gap persists into the eighth grade where it never becomes lower than -3 percentile points. This does indicate that a gender gap exists in the science classroom in Tennessee, although it is not as great as might be expected.

This gap stands out in contrast to female performance in the areas of reading and language comprehension, math comprehension, and social studies. In all of these areas, with some exception in social studies, females scored higher than males, especially in the area of language comprehension. A gap that was consistent in all areas would indicate an overall gender bias, but the results show that science stands out as being the one subject in which females consistently fall behind males. This is also surprising considering the gap in favor of females in the area of math comprehension.

The gender gap in science goes up and down by small amounts throughout grades 3-8. However, the gap is consistently present and although small, it represents a bias that matches national statistics presented by the literature. The appearance of a gap in all grades, unlike in the literature, poses the possibility that the causes of a gender gap may be present from the early years of schooling, and that they persist throughout elementary and middle school.

Hamilton County scores are relatively consistent with state-wide results, although there is slightly less of gap in grades 3 and 7, and a slightly greater gap in the grade 8. Also, females scored below males in math comprehension in eighth grade, a fact at variance with state-wide results. As with state-wide results, the gap between females and males in Hamilton County science scores is not a large one. Nevertheless, because the gap is consistent and is at variance with female to male gaps in other areas, further research and discussion of this issue is warranted and recommended.

Conclusion

The gender gap in Tennessee's grade 3 - 8 science classrooms is not as large as might be expected, and it does not emerge only in later grades. Because the gap is present, and also because it appears in stark contrast to female performance in other subject areas, educators in Tennessee schools should examine their curriculum and teaching styles in order to assess any biases that may be present. This examination should begin in the earliest grades, as the gap appears as early as third grade. It is hopeful that even the largest gap is below 10 percentile points, and therefore may be may be already on the way to elimination entirely. Hamilton County schools show the same issues in female performance in science, and should afford the same effort to overcoming this gap. Because national statistics still show fewer females in professional positions in science, all educators should reflect on all aspects of their teaching in the science classroom. While this gender gap still exists, we all suffer from the lack of skill and innovation that exists without a more equitable presence by females in the profession of science.

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